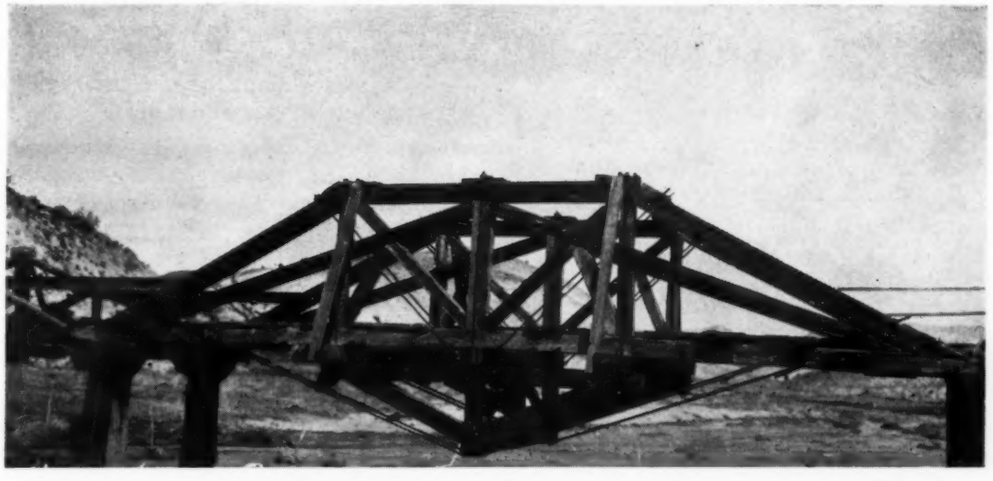
ROADS and STREETS

Vol. 80 No. 8 August, 1937

A GILLETTE PUBLICATION
ESTABLISHED 1906



Not a Bridge Designer's Nightmare But a Bridge Actually Taken over by the California State Highway Department. This Marvelous 50-ft. Span Crossed San Juan Creek.

WHAT ABOUT OUR OLD BRIDGES?

Present Heavier Motor Transport Units Make Old Bridges Weak Bridges

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ROADS AND STREETS

AS HAS been recognized and often mentioned by highway engineers and informed public officials, one of the anomalies of our North American highway program is the lack of close coordination between motor vehicle design and highway design. This lack of coordination is brought into sharp relief when a bridge fails, causing loss of life, injury, or heavy property damage, and a report is rendered by a bridge engineer giving the causes of the failure. Invariably such a report will show that the growth of motor truck weights and speeds have no relation to bridge strengths, whatsoever, where the truck is to be employed. When a railroad company decides to increase the weight and size of its locomotives, all bridges are reinforced or rebuilt to accommodate the increased loading and speed. Railroad executives have positive control over the whole problem and naturally, weak bridges are either strengthened or rebuilt to a heavier design, if heavier equipment is to be used. No

such positive control exists relative to highway transportation. True, legislation tends to control sizes and weights but this legislation is generally so liberal that were design standards to be employed in an analysis of an old bridge to see what permissible load should be allowed, it would seen be found that most truck transportation would be curtailed.

In an effort to be as liberal as possible and yet be assured that a reasonable degree of safety pertains, state highway departments are confronted with an old bridge problem which is quite serious. This problem resolves itself into three parts: first, a study of existing transport units now using the highways; second, rating standards to be employed in analyzing an old structure; and third,

What Happens to What Appear to Be Strong Bridges When Present Motor Transport Units Argue with Old Fashioned Stresses. This Is the Red Bluff Bridge over the Sacramento River. Note Trucks in the River.

legal responsibilities of highway personnel and the state as a whole relative to accidents caused through bridge failures.

This article is prepared for the express purpose of focusing attention upon this increasingly serious problem. Activities of the California State Highway Department are outstanding in this respect and the state is posting the bridges on the state highway system, limiting loads for certain types of vehicles.

Should an accident occur and a lawsuit result, engineers should be in position to support themselves by specification standards of rating for old bridges that are uniformly acceptable to officials responsible for highway construction and maintenance, and bridge maintenance in particular. The rapid growth of heavier, faster trucks, day by day increases the probabilities of disastrous accidents.

Nature of the Problem

Rating an old bridge for its load carrying capacity requires, in addition to the technical problems involved in computing stresses for given types of loads, a consideration of the legal restrictions governing types of loads permitted by state laws and the nature and amount of legal responsibility connected with the maintenance of a relatively weak bridge.

In order to determine the load capacity of an old bridge for posting, it is necessary to know, or to estimate:

1. The nature of the maximum loading which will cross the bridge. This involves the weight and placement of the separate wheel loads and the distribution of the resultant stress to various members of the bridge.
2. Advisable factors of safety to use. Because the bridge is old, certain unknown factors and conditions exist. There also exists the possibility that loads or impacts greater than those estimated as coming on the bridge or loads heavier than the legal maximum may cross it so that the critical maximum condition of loading exists thus causing greater stresses than assumed. While it is possible for these conditions to pertain, the probability of the occurrence is more or less remote, thus raising the question of liberalization of the factor of safety.

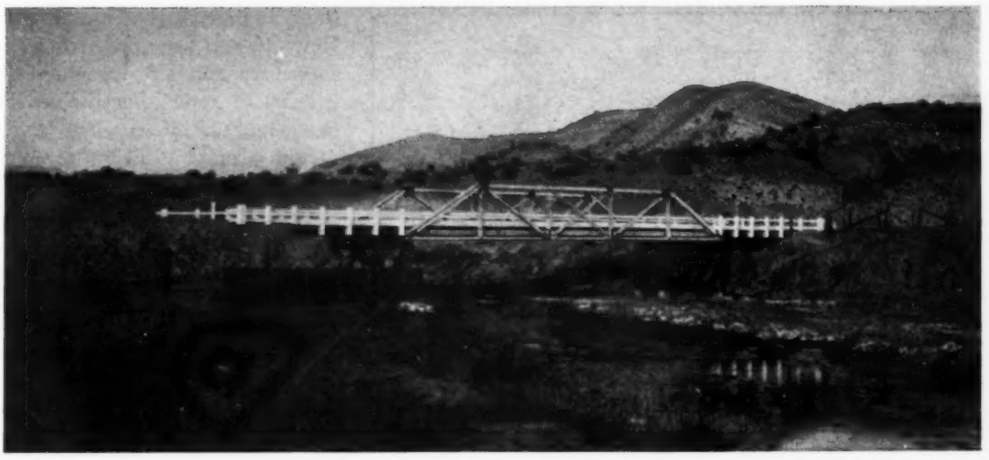
Permissible Vehicle Loading in California

Weight restrictions in the California vehicle code have resulted from periodic legislation formulated without the advice of the state highway bridge department or any other structural engineering body. In general, they are as follows:

The gross load on any axle is limited to 17,000 lb. and on any one wheel to 10,000 lb. except for vehicles first registered before Jan. 1, 1930, which are allowed 18,000 lb. and 11,000 lb., respectively. The two axle truck gross loading is 26,000 lb. regardless of the spacing but a two axle passenger vehicle with dual wheels on the rear and equipped with low pressure tires all around is allowed a maximum of 28,333 lb. A two axle semi-trailer (axles spaced between 40 in. and 48 in.) is likewise allowed a gross load of 26,000 lb. A three axle truck is restricted to 34,000 lb., which is the maximum load allowed on any single vehicle.

The number of trailers that can be assembled within the maximum legal length of 60 ft. is unrestricted, but no combination of vehicles can exceed a gross load of 68,000 lb. The code also limits the loading of any vehicle or combination of vehicles to $W=1750\ (L+8)$, where "L" is the distance in feet between the first and last axles of the vehicles or combination.

This equation is not satisfactory from the viewpoint of posting old bridges because it does not prevent increased load concentrations that are destructive to these bridges. A factor that limits the spacing of axles should be included. An equation suggested by the bridge de-



This Bridge Replaced the Undefinable 50-ft. Truss over San Juan Creek. It Was Salvaged from Another Site and Re-erected Here.

partment for California conditions is W=2100 (2 N+L), where "N" is the number of axles and "L" is the spacing in feet between the axles. A curve on an accompanying chart of curves, Fig. 1, shows how the suggested equation when converted into moments does not prohibit operation of any existing equipment but would prohibit increasing the weight concentrations unduly, by changing wheel spacing or increasing loads.

Curves on Fig. 1 show comparative allowable bending moments of a simple beam for various span lengths using different loading equations. The standard A.A.S.H.O. loadings of H-15 and H-20 for new designs are plotted with the U.S.B.P.R. equation, W=C(L+40), using the New York constant of 750 for "C". The state of California made field surveys of actual truck dimensions and loads from which data they plotted the curve of existing loads. The curve of maximum loads using the present code limitation of 1750 (L+8) also includes practicable limitations of vehicle construction for wheel spacing and manipulation of semi-trailers. The suggested equation, W=2100 (2N+L), is plotted to show how the code could be changed to control load concentrations without prohibiting operation of present equipment yet keeping loading within reasonable bounds.

Under existing circumstances the problem of devising a gross weight formula for California to restrict too close coupling is difficult. It must control spacing of the excessive four axle combination (two rear axles of the three axle tractor and two axle semi-trailer) and, at the same time, restrict the heavy three axle combinations, two rear axles of a three axle truck and the front axle of a trailer or the rear axle of a two axle truck and the axles of a two axle semi-trailer). The following formula appears to fit the conditions in California:

> "In any vehicle or combination of vehicles operating upon the highways, the gross weight in pounds of any three or more consecutive axles shall not exceed 2,100 multiplied by (2N+L), where "N" is the number of axles in the group under consideration and "L" is the distance in feet between the first and last axles of this group".

This formula has no precedent in the legislation of other states, and probably would not be suitable for other states. It is expressly designed to apply to vehicles and combinations of vehicles which are operating under the present California motor vehicle regulations. It is more severe than the formula W=750 (L+40) in the reduction of loads for very closely coupled units, but this reduction is in proportion to the increased stress induced in highway structures by the reduced spacing of heavy axles. Furthermore, although the rate of reduction is greater, this formula would allow carrying a full legal load by shorter units than does the A.A.S.H.O. formula, and only a very small percentage of vehicles operating upon the highways today would be affected. This formula is directed at a present tendency toward very close coupling of heavy equipment and would safeguard California's bridges against freak vehicles and combinations which might be built for special types of work, such as ore hauling.

A study of the suggested formula as applied to standardized units now using the roads is presented in Fig. 4. This chart shows what the minimum spacing of heavy

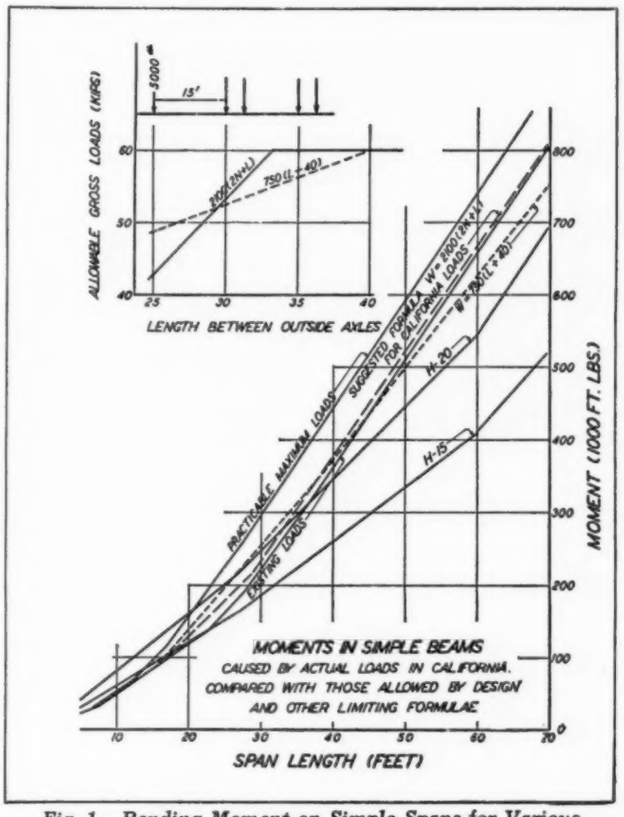


Fig. 1.—Bending Moment on Simple Spans for Various Loadings.

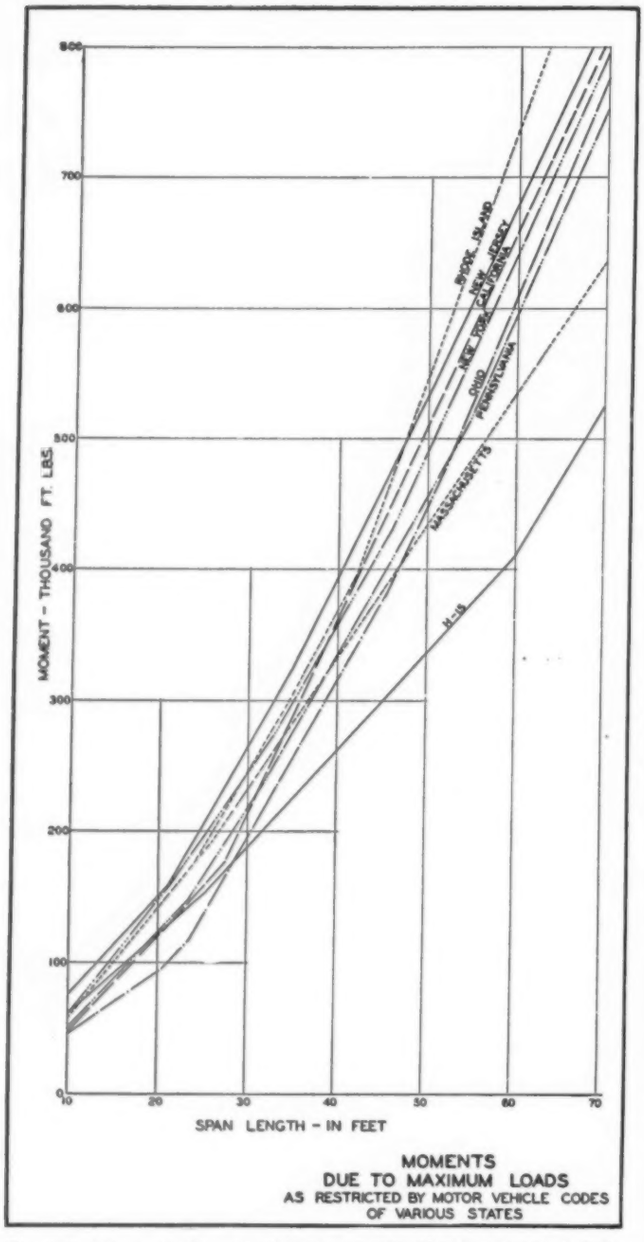


Fig. 2.—Moments Due to Maximum Loads As Restricted by Motor Vehicle Codes of Various States.

axle loads would have to be to conform with legal maximum loading as governed by the proposed formula. After a certain point service life of old bridges materially shortens or maintenance costs become excessive. To prevent this the limiting equation is suggested.

Except for the New York curve, W=750 (L+40), where a gross weight formula definitely limits the maximum load, the curves in Fig. 1 are not based on maximum possible moment loadings but upon maximum loads permitted in the various states, combined with an assumed axle spacing. The axle spacings assumed were only slightly more severe than those of the average vehicle. The same axle spacings were used in all calculations so the moments would be comparable.

Another graph, Fig. 2, shows moments due to maximum loads as restricted by motor vehicle codes of various states. It is included here to show comparative conditions of liberality of motor transport. Rhode Island and New Jersey are more liberal regarding motor vehicle capacities and axle spacings than California. However, it must be remembered that these two small states have dense population and the bridges on the state highway system are about all built, and to a high standard of construction.

Standard Adopted

From data secured through various traffic surveys, the Bridge Department of the State of California computed the average axle spacing and set up a standard three axle tractor and two axle semi-trailer combination to be used in computing the stresses in existing bridges. The standard vehicle has maximum legal axle weights and represents otherwise, an average vehicle of this type operating on the highways. It actually causes live load stresses in bridges of all but the shortest spans far in excess of the H-15 design standard. It will be recalled that in an above paragraph the statement was made that if H-15 loading were used to post existing bridges, freight traffic would be virtually stopped. The excess live load stress over the H-15 design load amounts to a maximum of 60 percent for girders of 60 ft. span. *However, this is the existing and not a maximum possible condition.* There is nothing in California's motor vehicle laws to prevent close coupling of these heavy axles as close as is physically possible. As stated before, the regulation, W=1750 (L+8), is entirely ineffective in preventing this. Increased stresses due to close coupling of

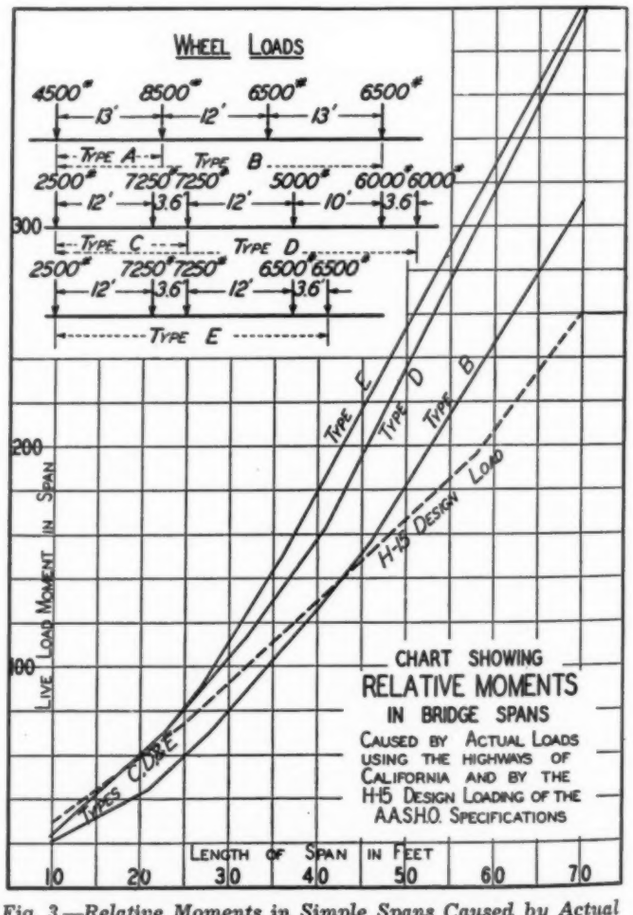


Fig. 3.—Relative Moments in Simple Spans Caused by Actual Loads Now Traveling the Highways of California.

heavy axles is most severe for span lengths of 15 ft. to 40 ft., which lengths include the major percentage of old bridges and all highway structures.

The chart, Fig. 3, shows relative moments in bridge spans caused by actual loads, reduced to standard types, travelling the highways of California. It will be noted that the plate shows Types A, B, C. D and E. For old bridge analyses, tentative specifications now being used by the bridge department section on Special Investigations (which posts the bridges) include also types F, G, and H. They are different motor vehicle types and combinations now using the roads.

Rating Standards for Old Bridges

Loading Standards—In previous paragraphs the nature of maximum loading which will cross a bridge has been discussed as part of the larger problem of legal loads and limitations. Actual transport units as now traveling the roads were discussed and a formula suggested which would tend to limit further destructive load concentration. For rating old bridges, the chart, Fig. 5, is being used and reflects actual conditions. With these loadings

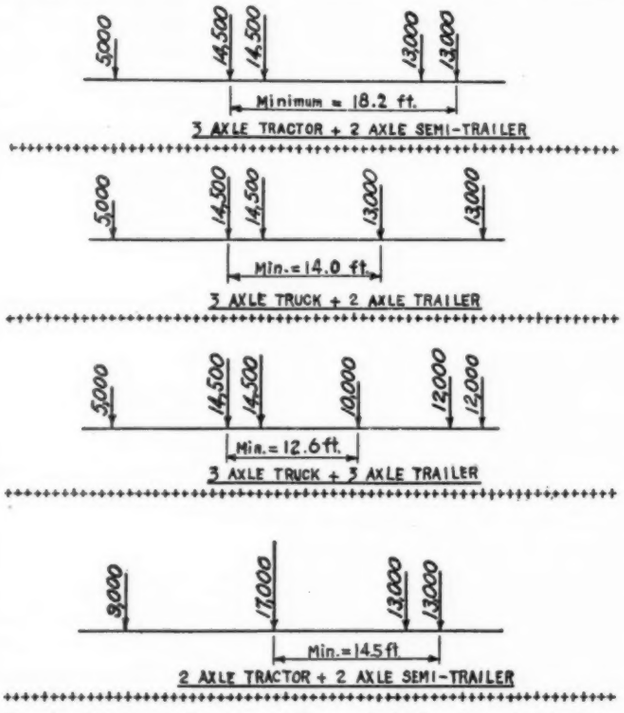


Fig. 4.—Minimum Spacing of Heavy Axle Loads as Limited by W=2100 (2N+L)

the table in Fig. 6 was prepared to facilitate rapid analysis of an old bridge. Similar tables have been prepared for forces acting in other parts of the structure.

Factors of Safety—The most important part of the analysis of an old bridge structure is the determination of what unit stress to adopt, which is merely another way of stating what factor of safety to employ. It is at this point that the engineers' skill and judgment is exercised. The object is to determine what is a safe loading to use in posting the bridge. Fundamentally, this requires the judgment of an experienced engineer who has studied destruction caused by the many agencies that incessantly tend to deteriorate the materials or construction. Factors of safety are often referred to as

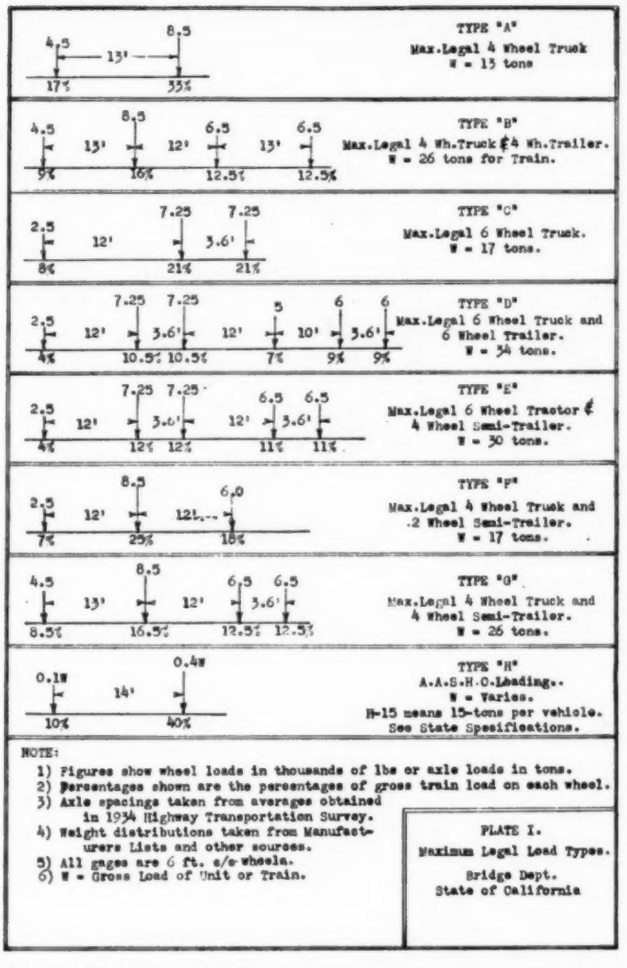


Fig. 5.—Maximum Actual Legal Load Types Used for Rating Purposes.

factors of ignorance since they cover the uncertain and unknown factors connected with the bridge construction, or the theoretical formula used to compute the stresses originally, or the mechanical and variable properties of the materials of which the bridge is composed. If a high (or even commonly accepted) factor of safety is used the safe load for an old bridge is usually found to be unnecessarily low and an economic hardship is inflicted upon motor freight operators as well as the community served by the bridge. On the other hand, if too low a factor of safety is used, or a low factor is employed on the probability that the stress adopted may not be reached before the bridge is replaced, and working stresses too near the point of failure are adopted, a serious accident may result. In any event, high maintenance costs and short service life can be assured by a too low factor of safety.

In the design of new structures factors of safety are used which have been determined by a general agreement among competent engineers whose judgment is based upon the results of experience and tests. In focusing our attention upon the old or existing bridge problem as viewed in the light of increasingly heavier motor transport units, the question is raised as to whether or not factors of safety as used in the design of new structures should be applied to the same degree as when determining the safe load for posting an old bridge.

One of the Many Old Bridges Posted in California Limiting Loads to Certain Capacities. This Bridge is over the Sacramento River near Redding. While This Bridge Appears to Be Heavy Enough, Investigation Has Shown That Restricted Loadings Were Mandatory.

The principal uncertainties to be considered are:

1. Variation of stresses caused by variable axle loadings and spacings, relative placement of load on bridge floor, and probability of critical loading.
2. Approximated assumptions of theoretical formulae.
3. Variability of strength properties of individual pieces of materials.

Stress Variation—Heavy vehicles using the highways produce stresses in bridge members which vary with the axle loads, axle spacings, relative placement of the load on the bridge floor, and the number of such vehicles that can come or are likely to come on the bridge at one time. The limitations placed upon load carrying capacities of motor freight vehicles by their design, and the laws of the various states, are not uniform and constant. It is quite evident, therefore, that what may have been a reasonable factor of safety at the time when the bridge was built, considering the loads of that time, is not the same factor of safety considering the loads now traveling the highways. It is certainly uneconomical, whether or not advisable, to assume for posting an old bridge that a combination of loads will so occur upon a bridge member as to be in the exactly most critical condition of loading, when the probability of this occurrence is negligible, even though theoretically possible. On the other hand, it would be considered unwise to estimate the "most probable" load combinations to use in calculating maximum stresses without some added factors of safety.

In the design of a new bridge, allowance is made by common factors of safety to cover the probabilities that state laws may be changed at some future time to permit increased loadings, whereas in analyzing an old bridge for posting the action is taken as a temporary protective expedient and can be changed as the laws are changed. The definite knowledge, in California, of the assumed loads furnishes a reason for them to make some reduction in safety factors when computing load limits for an old bridge in comparison with generally accepted safety factors used in design.

Theoretical Formulae Assumptions—Theoretical formulae which are commonly used in computing internal stresses involve assumptions that are known to represent only approximately the actual distribution and effect of force caused by loadings. The accuracy of the data or the knowledge of future conditions usually does not warrant the use of more accurate formulae if the assumptions are known to be on the safe side. In some

TABLE OF LIVE LOAD MOMENTS + IMPACT
ON STRINGER SPANS

PLATE II.

Span c/c Feet	Live Load Moment + Impact. 1000 '# Types of Loadings								Span c/c Feet
	A.	B	C	D	E	F	G	H-15	
4.	11.1	11.1	9.4	9.4	9.4	11.1	11.1	15.6	4.
5.	13.8	13.8	11.8	11.8	11.8	13.8	13.8	19.5	5.
6.	16.6	16.6	14.1	14.1	14.1	16.6	16.6	23.4	6
7.	19.3	19.3	16.2	16.2	16.2	19.3	19.3	27.3	7.
8.	22.1	22.1	22.6	22.6	22.8	22.1	22.1	31.2	8.
9.	24.9	24.9	27.1	27.1	27.1	24.9	24.9	35.1	9.
10.	27.6	27.6	31.7	31.7	31.7	27.6	28.4	39.0	10.
11.	30.4	30.4	36.3	36.3	36.3	30.4	32.5	42.9	11.
12.	33.1	33.1	40.9	40.9	40.9	33.1	36.6	46.8	12.
13.	35.9	35.9	45.5	45.5	45.5	35.9	40.8	50.7	13.
14.	38.7	38.7	50.1	50.1	50.1	38.7	44.9	54.6	14.
15.	41.4	41.4	54.7	54.7	54.7	41.4	49.1	58.5	15.
16.	44.2	44.2	59.4	59.4	59.4	44.2	53.2	62.4	16.
17.	47.0	47.0	64.0	64.0	64.0	47.0	57.4	66.3	17.
18.	49.7	49.7	68.7	68.7	68.7	49.7	61.6	70.2	18.
19.	52.5	52.5	73.4	73.4	73.4	52.5	65.8	74.1	19.
20.	55.3	55.3	78.0	78.0	78.0	55.3	70.0	78.0	20.
21.	58.0	58.0	82.7	82.7	82.7	58.0	74.2	81.9	21.
22.	60.8	60.8	87.4	87.4	87.4	60.8	78.4	85.8	22.
23.	63.5	67.2	92.1	92.1	92.1	66.6	83.3	89.7	23.
24.	66.9	71.8	96.8	96.9	97.9	71.1	90.1	93.6	24.
25.	71.0	76.4	101.7	105.2	104.6	75.7	96.9	97.5	25.
26.	75.1	81.1	107.1	109.4	111.3	80.1	103.7	101.3	26.
27.	79.1	85.7	112.5	115.7	118.0	84.6	110.4	105.0	27.
28.	83.1	90.3	118.0	121.9	126.3	89.4	117.2	110.3	28.
29.	87.2	95.0	123.4	128.1	134.8	94.8	124.0	115.1	29.
30.	91.2	101.1	128.7	134.2	143.2	100.1	130.6	119.7	30.
31.	95.2	107.5	134.1	140.4	151.6	105.5	137.4	124.0	31.
32.	99.2	113.8	139.5	146.6	160.1	110.9	144.1	128.1	32.
33.	103.3	119.7	144.9	153.5	168.5	116.2	150.9	133.8	33.
34.	107.3	126.0	150.2	160.4	177.1	121.6	157.6	138.5	34.
35.	111.3	132.1	155.6	167.4	185.6	127.0	164.3	143.2	35.
36.	115.4	138.3	160.9	174.4	194.2	132.3	171.0	147.9	36.
37.	119.4	144.5	166.3	181.3	203.6	137.6	177.8	152.6	37.
38.	123.4	150.6	171.6	188.2	213.1	143.0	184.5	157.2	38.
39.	127.5	156.8	177.0	195.2	222.4	148.3	191.2	161.9	39.
40.	131.5	162.9	182.3	202.1	231.7	153.6	197.9	166.6	40.
41.	135.5	169.0	187.6	209.0	241.1	158.9	204.5	171.2	41.
42.	139.5	175.1	192.9	216.5	250.4	164.2	211.2	175.9	42.
43.	143.5	181.3	198.2	223.7	259.8	169.5	217.9	180.5	43.
44.	147.5	187.3	203.5	233.7	269.1	174.8	224.7	185.2	44.
45.	151.4	193.8	208.8	243.7	278.5	180.2	231.4	189.8	45.
46.	155.4	199.8	213.8	253.1	287.5	185.2	238.1	194.5	46.
48.	163.4	211.6	224.3	273.7	306.0	195.8	251.4	203.5	48.
50.	171.3	223.5	234.8	294.3	324.5	206.3	264.8	212.7	50.
52.	179.2	235.4	245.2	314.9	343.0	216.7	278.1	221.9	52.
54.	187.1	247.4	255.6	335.5	361.4	227.1	291.4	231.0	54.
56.	194.9	259.2	265.8	355.7	379.4	237.3	304.7	239.9	56.
58.	202.7	271.1	276.1	376.2	397.7	247.7	318.0	249.0	58.
60.	210.5	282.9	286.4	396.6	415.9	258.0	331.4	258.2	60.
70.	249.2	341.9	337.1	497.8	505.8	308.8	398.0	303.6	70.
80.	287.1	400.4	386.8	597.5	594.1	358.8	464.7	348.2	80.
90.	324.4	459.5	435.6	695.7	680.8	407.8	531.4	392.5	90.
100.	361.0	518.5	483.5	792.2	765.9	455.8	597.1	436.5	100.
120.	432.1	636.2	576.4	980.1	931.3	549.2	729.1	523.9	120.
140.	500.8	753.3	666.2	1162.	1091.	639.4	858.4	608.2	140.
160.	566.3	869.5	751.7	1335.	1243.	725.4	984.2	688.5	160.
180.	629.0	984.5	833.5	1502.	1389.	807.7	1106.	764.5	180.
200.	688.8	1098.	911.5	1661.	1529.	886.2	1224.	836.2	200.
250.	826.6	1378.	1091.	2028.	1850.	1067.	1514.	1015.	250.
300.	946.0	1632.	1247.	2347.	2128.	1224.	1768.	1172.	300.

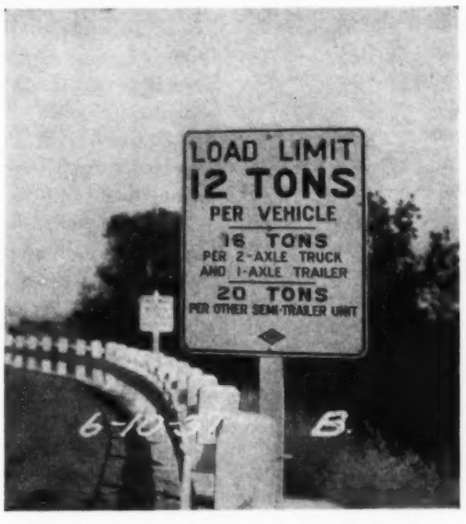
(Moment values shown are for one wheel line only.
Underscored figures indicate a change in the load condition.
Impact is 30% for all spans up to 25 ft. From 25 ft. to 300 ft. use a straight line variation from 30% to 0%.

Fig. 6.—One of a Set of Tables of Moments for Rapidly Calculating Stresses in Old Bridges, Based on Loadings Shown in Fig. 5. Tables Have Been Developed for Various Members of Different Bridge Types.

Approach to the Sacramento River Bridge near Redding.

cases, however, knowledge of the action which takes place is so meager that it is doubtful if the formulae used can be considered even approximately correct, and the effect of the action is often ignored altogether in the computations with the hope that the factor of safety allowed will cover any errors involved. Forces causing stresses which, from a practical standpoint, can not usually be figured with any degree of accuracy are: Dynamic forces including those produced by harmonic vibrations; forces produced by temperature or other internal forces causing expansion and contraction; and the effect on stresses caused by sudden changes in section, rigid connections or settlement of foundations. Knowledge is incomplete on deterioration which causes stress increases, such as rusting, rotting, swelling, crystallization and wear. Inspection of an old bridge which has been in service a number of years will generally disclose whether or not any detrimental action due to the above causes has taken place, and if no such action is evident, this knowledge should permit of the use of somewhat higher working stresses for posting than those used at the time the bridge was designed.

As a matter of general principle, the refinements used when calculating stresses in an old bridge should conform to the thoroughness of the field inspection which determines its actual condition. It is also considered advantageous to use theoretical formulae that, as far as practicable, include and call attention to all factors which affect the stress under consideration.



Type of sign used for posting a California bridge.

Variability of Strength Properties—Any material of a given grade, even when free from ordinary manufacturing defects, shows variability in the strength properties of individual pieces. Present allowable design working stresses for such material are based upon its probable minimum strength and this means that the strength of the *average* structural member will be *greater* than was assumed. Undoubtedly this is often the reason why bridges carry heavier loads than they were designed to carry, but any dependence on such a factor of safety (before the bridge is built) would, of course, be a pure gamble. In addition to what might be termed the natural variation in the strength of a material, mechanical defects may occur in its manufacture, fabrication or preparation for use in the structure. When building a new bridge, such defects are kept within certain limits by suitable specifications, laboratory tests and inspection during construction.

In rating an old bridge it is often impracticable to determine definitely the exact nature and grade of material that was used, but if a thorough and comprehensive inspection can be made and no sign of incipient failure is observed, the simple fact that the bridge is giving service is proof, to some extent at least, that no mechanical defects exist, or if they did exist they were satisfactorily remedied. In this case the investigator is justified in lowering the factor of safety for posting purposes. The factor of safety in new timber bridge designs is often required to care for a certain amount of future decay or deterioration. In rating an old timber bridge, the investigator will inspect for all evidence of decay or other deterioration and give it due consideration in computing safe loads, either by a proper reduction in the effective section of the member or by some other logical method.

Granting that competent inspection will permit relatively lower factors of safety in computing safe loads for an old bridge where the ratings so determined are to continue in force only so long as the conditions continue, there is still a big problem to be solved in determining just how much they can be reduced. The answer will be found in the composite judgment of competent engineers after they have studied the results of previous tests and actual experience.

California Posting Practice—The state of California in posting its weak bridges for reduced load limits has adopted a set of tentative specifications and rules for checking the live load capacity. It is their practice to sign a bridge for the gross load that each type of vehicle may carry. They need the cooperative support of competent engineering judgment in this work upon which to rely in case of suit from serious accidents or failures. The bridge department's section on Special Investigations is steadily collecting data and making studies of actual bridge loadings, safe allowable stresses and stress distribution, to better substantiate its choice of load limits for old bridges.

Legal Responsibilities of Highway Personnel and the State

This subject is quite involved and space does not allow its presentation here. Suffice it to state that legal opinion of California State Highway Department attorneys indicates that highway personnel as well as the state may be criminally liable in case of serious accident if they have a knowledge that the bridge was not strong enough to support the load where the accident occurred.

The matter of determining the exact condition of a bridge in order to avoid the charge of negligence is not always an easy one and the proper method of properly warning or restricting traffic using old bridges involves many complications.

THE TREND OF MODERN HIGHWAYS

By THOS. H. Mac DONALD
Chief, U. S. Bureau of Public Roads

ANY attempt to reach far into the future of highway development invades a speculative field if limited to isolated examples of the unusual. However, if taken as a whole, each one of the major public undertakings changes slowly in character through definite causes. These changes, if relatively slow, are none the less sure and continuous, depending upon the rate of progress in science and invention and upon movements in the social structure.

The most important causes of change in highway utilization and improvement, viewed nationally and in the mass, have in themselves a variety of checks and balances which determine their actual course and influence. For example, the national market for large numbers of motor vehicles has resulted in the investment of so much capital, the growth of industrial plants of such large dimensions, and the establishment of such complicated routine of production, that year to year changes in the product are limited by the necessity of conserving the investment in plant by the requirements of mass production and by considerations of time. Thus, the change in the motor vehicle becomes definitely pronounced over a fairly long period, rather than from year to year.

Factors Determining Trend

Thus, the most serious loss in the highway investment over the past decade is the obsolescence resulting from changes in the number and speed of motor vehicles operating on the highways.

The revenues accruing to the public treasuries from the special taxes levied upon the motor vehicle and its users in all the various forms have been increasing in their total over a long period save for the temporary recession during the worst of the depression years.

First intended and levied for highway improvement, the growth of income from these special taxes should permit highway officials to build more adequate and consequently more costly roads. But because there have been large diversions of this income to other purposes, and because these funds have been spread over an ever increasing mileage, many States are faced with a constantly growing financial dilemma.

Highway research is moving forward steadily on many fronts with definite objectives. The responsibility for carrying on intensive studies in the physical and economic fields, has been accepted as a continuing obligation by highway engineers and scientists in allied fields. Concurrently, the necessity for greater street and highway safety has become a national emergency.

These are but a few of the factors which will determine the trend of modern highway development, but they are the most important.

The First Great Decentralizing Agency

Faced with the constantly increasing demand for the construction of new highways and the spreading of the income over a rapidly growing mileage, the highway officials, State and Federal, realized the impossible situation developing and in a number of States actually current. Out of this situation was born the Statewide highway planning surveys which are now being carried on cooperatively in 44 States and the Territory of Hawaii. These surveys and supplemental studies will present a factual basis upon which to plan the complete administration of all the highways based upon sound principles and factual data. One of their important phases is the determination of the relation of the highway to other types of transportation and communication and to population distribution.

Beginning with water transportation and continued by railroad development, the influence of transportation in the past has been exerted to concentrate large populations in small areas. It is only necessary to examine the maps of this country, or any other, to visualize clearly the concentrations of population in cities which have resulted inevitably from the characteristics of waterway and railway transportation.

Highway transportation by motor vehicle is the first great decentralizing transportation agency. The first notable effect of this dispersing influence is the formation of the wide bands of suburban development around the cities. Even cities of moderate size have developed, within a decade, a suburban band five to ten miles in width, and depending upon topography, partially or completely enveloping the old city. The automobile in conjunction with rail suburban service has attracted city workers to make their homes in rural districts for distances easily up to 50 miles from the city.

Scientific Planning Most Characteristic Trend

The next logical step is the breakdown of over-sized industrial units into smaller units that will be free of many of the undesirable characteristics of over concentration, yet of sufficient size to retain the economies of mass production. Sufficient progress in this direction has already taken place to indicate how inevitable must be this process even though slow. It is reasonably well established that economy of production can be secured in units of moderate size, and the national thought along social lines is becoming a potent force toward decentralization because of the opportunities presented for a more healthful and more desirable mode of life for the workers and their families.

It will be noted that no conjecture or uncertainty is involved in these statements, but simply a recognition of

existing facts. The implications are clear that the scientific planning of highways and highway systems of State-wide and Nation-wide dimensions will be the most characteristic trend in highway development.

Without such scientific administration there will be no possibility of providing adequate highways to serve both urban and rural needs, or to keep the cost of highway improvement, including maintenance, within the limits of revenues that can be raised by reasonable road user taxes. This means a reversal of the present trend in many States where the maintenance cost of the rapidly growing mileage of local poorly built roads is mortgaging far too large a portion of the highway budget. This situation has been produced largely by legal mandate and other public policies adopted and pushed into effect without any consideration for sound highway administration. The Nation-wide movement, through the State and Federal highway departments, to place highway administration on a sound economic engineering basis, is not only the most important trend, but is also the cause of other trends which on this account may be predicted with some certainty. Out of the planning surveys will come definite specification for the division of highways into groups classified by the service they are called upon to perform. By research and experience the details are being rapidly defined that will determine the general type of highway design for each highway service group. In this the principal items will be the alignment with limiting curves, sight distances, the number of traffic lanes, their widths, the shoulder widths, divided roadways for multiple lane highways and many other details.

The trend here is first to classify highways, based upon service, and next to design closely in accord with the classification—contrasting with the all too prevalent practice in the past of applying single standards to long mileages, and without change, to roads of widely varying traffic service requirements.

Soil Stabilization Important Development

In the field of highway design, the most important single development is found in the possibilities of soil stabilization. The intensive research work of more than a decade has borne fruit in the understanding that now exists of the physical and chemical properties of soils and methods of utilizing the knowledge no longer stop at mere superficial applications to the immediate subgrade, but go further, to affect the entire graded roadbed in both cut and fill sections. Among the most important additions ever made to the highway organization are the soil technician and his specialized soils laboratory. The application on a broad front of this new knowledge will come as rapidly as engineers may be given the specialized training, and as a result there will be for the first time the possibility of building really scientifically designed roadway sections since these will be placed upon foundations of predictable behavior.

Grade Crossing Elimination Fixed Policy

With a large program of grade separation under way at railway and highway intersections and with the changed public policy in paying construction costs largely from public funds, grade crossing elimination has become a fixed policy that will continue until all important railway-highway grade crossings have been eliminated and minor ones protected by adequate devices.

This same policy is being rapidly extended to the separation of important highways at intersections and one of the important trends of highway design in the immediate future will be to rule out intersections at grade as a possibility in efficient highway design.

In this connection, incidentally, the widespread use of "stop" and "go" lights is not a solution for traffic movement, but has been a development of necessity imposed upon a system of highways designed and built before the present dimensions or speeds of highway traffic were considered possible. Obviously, the trend of highway improvement in the future must be to provide in the congested area traffic flow arteries that will permit continuous flow of traffic from downtown areas well into the suburban areas. While the cost will be high, it is only through such arteries that capital invested now in land and buildings in the hearts of the business districts, can be even reasonably preserved.

The pioneer roadway even on main traffic routes was conceived as the single important objective. Now, with the recognition of values inherent in highway transportation beyond the bare utility, the roadway design has come to embrace the whole right-of-way. The trend of modern design is to provide landscaping of the roadsides, side walks, foot paths, bridle paths and to stop and protect against soil erosion. The required additional attention and expense, are paying large dividends through greater durability and through the recreational values inherent in attractive waysides.

There is more or less discussion in which the term "super-highways" is used without any adequate definition of what is intended by this term. Perhaps, it is more frequently used in connection with a very limited number of transcontinental highways designed for high speed and with multiple lane roadways to carry traffic from coast to coast.

The German System of Super-highways

The German system of super-highways which is now under construction embodies this idea. In that country a system of approximately 4500 miles of highways, which gives approximately three lines across the nation in each direction, is being built on wholly new, wide rights-of-way without access from abutting lands except at infrequent intervals. This design is for high speed, motor vehicle through traffic. The travel section is composed of two roadways about 30 ft. in width separated by a parking. Both the horizontal and vertical alignment are exceptionally good. All cross traffic is carried over or under these highways. No detail that comes within the purview of highway engineering that will make a more safe or efficient highway has been left out. The most advanced highway design technique has been embodied in this development. The economic utilization is not so clear.

In this country there is need for a considerable mileage of highways having similar characteristics, but the disposition of this mileage to be most efficient must be planned on the basis of the careful studies now going forward. The system of German roads is being built in advance of, and to promote the development of, highway transport. In the United States the situation is just the reverse. We are proceeding on the principle that the utilization of the highways must directly produce the revenues with which to finance their construction. So

long as we adhere to this method of financing, the building of super-highways must be limited to those areas where the present and prospective traffic will justify. As a trend of highway development, it is apparent from the important beginnings already made here that a considerable mileage of motor super-highways will be developed, that their location will be carefully integrated with the population centers and that the layout will not be on the transcontinental basis.

In France, where a system of national roads has been developed over a long period, the present construction is to take care of the traffic around the metropolitan districts, particularly the vicinity of Paris by a system of circumferential and radial roads in combination. Here the detail of outstanding importance in the design is the separation of cross traffic.

From the developments abroad and in this country we can conclude that super-highways will be developed but only in the vicinity of our metropolitan areas for relieving traffic congestion within these areas and for connecting metropolitan areas which are separated by relatively short distances. The first function has already been served to a considerable extent by parkways. It is logical that there will be further developments of the type of the Blue Ridge Parkway now under construction to connect the Shenandoah and the Great Smoky Mountain National Parks. The development of such parkways recognizes the large use of motor vehicles for recreational purposes.

Finally, the power of highway improvement to accelerate the shift of population from areas of low productive potentials to areas more favorably conditioned will be consciously used in the national policies developed for the long-term attack upon land use problems. A definite start is already being made in this direction and will become more apparent in the layout of the system of secondary or feeder roads. This thought definitely emphasizes that we have completed the pioneer stage of road development and every trend of highway development of the future must be an intelligent meeting of the particular service to be rendered.

Acknowledgment: The foregoing is a paper presented July 21 at the 67th Annual Convention of the American Association of Civil Engineers.

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Lumber Planning Big Demonstration at 1939 Fair

Plans are under way for a great western lumbermen's conclave in San Francisco and Oakland during the Golden Gate International Exposition in 1939, and the lumbermen will seek to have at least one day of the Exposition program set aside as "Lumber Day." Lumber industry exhibits will also be considered by the committee in charge, with cooperative efforts to encourage the fullest use of exposition facilities.

Included in this committee membership are representatives of the National Lumber Manufacturers Association, West Coast Lumbermen's Association, Western Pine Association, California Redwood Association, plywood manufacturers, timber engineering organizations, wholesale and retail lumber dealers' groups of San Francisco and the East Bay and lumber trade publications.

Third Montana Bituminous Conference in Glacier Park, Sept. 7, 8, 9

The Third Montana Bituminous Conference, combined this year with the National Road Oil & Asphalt Congress, will convene in Many Glaciers Hotel, Glacier National Park, Montana, Sept. 7, 8 and 9. The combination of the two conferences devoted exclusively to discussion of methods of design, construction and maintenance of bituminous highways is expected to attract more than 500 highway engineers, contractors and producers in the bituminous field.

Don A. McKinnon, Helena, Mont., state highway engineer of Montana and general chairman of the conference, has announced a program in which every state as well as several provinces of Canada, some countries in Central America and South America have been asked to participate. Acceptances have been received from most of those invited and it is expected that the record of last year's conference, in which 28 states, 2 Canadian provinces and Argentina were represented, will be broken by a wide margin.

The method of organization at the Montana conferences has been unique in that, although the papers presented for consideration have been voluminous and comprehensive, the actual presentation from the floor represents only a condensation and a summary of the prepared material. Last year, for example, although 24 papers, dealing with bituminous problems extensively and in detail were prepared, only four were delivered from the conference floor. Those four papers, however, contained the wealth of material combed from the primary papers.

The same method will be followed this year with only four papers being delivered from the floor by the chairmen of the sections assigned to study particular problems.

The four general sections of the conference will be:

Research Correlation and Development of a Bituminous Bibliography. R. N. Traxler, Barber Asphalt Company, Chairman.

Developments in the Fundamentals of Bituminous Construction. A. H. Benedict, Bureau of Public Roads, Portland, Ore., Chairman.

Developments in the Practical Design and Construction of Bituminous Surfaces. B. E. Gray, Chief Engineer, The Asphalt Institute, Chairman.

Maintenance of Bituminous Surfaces. H. H. Houk, Bituminous Engineer, Alabama Highway Department, Chairman.

Each of the chairmen will present papers which combine and condense material submitted by eight or ten committee members. In the printed record of the conference, the primary papers of the committee members, as well as the chairmen's summation, are included.

Assisting Mr. McKinnon in the organization and operation of the conference will be a conference board, composed of the chairmen of last year's conference.

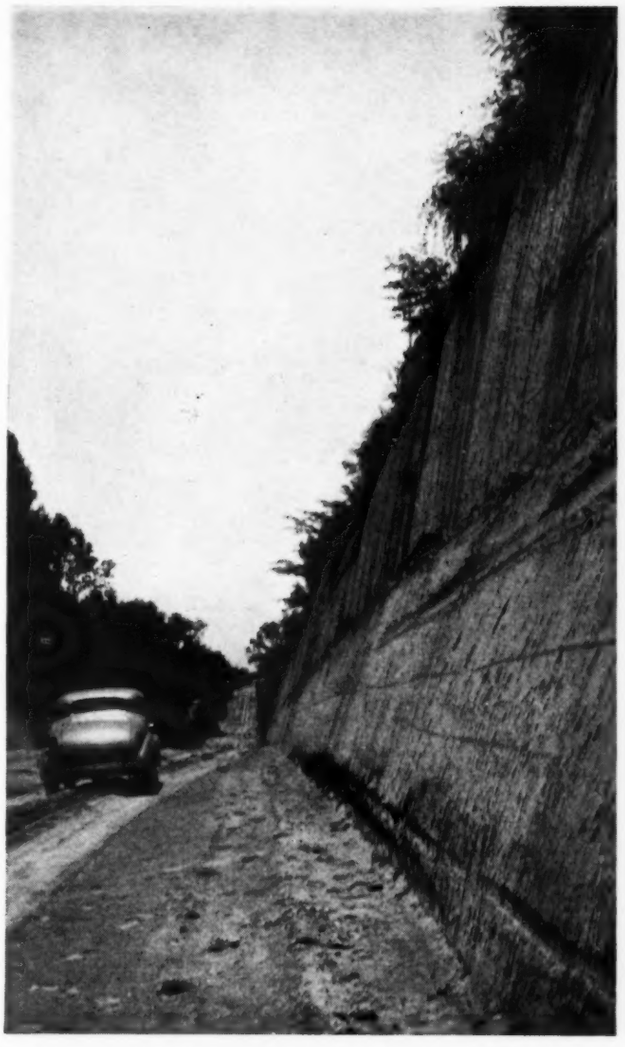
The Montana Meeting in its previous sessions has established a reputation as a working meeting in which a skillful blend of entertainment has been injected by the hosts and by the natural scenic beauty of the region.

CURRENT CONSTRUCTION IN SOUTHWESTERN MISSISSIPPI

Bridges and Grading of Special Interest on U. S. Route No. 61 South of Vicksburg

By JOHN C. BLACK

Field Editor
Roads and Streets



Close-up of a deep Loess cut on Cage Brothers' Job in Warren County.

FROM historic Vicksburg through equally historic Natchez to Woodville near the Louisiana line, old U. S. Route 61 winds 128 miles across and around hills and through loess canyons. It is picturesque and beautiful but not a modern highway. The gravel surface is about 18 ft. wide and in many places the shoulders are painfully narrow. There are many sharp turns, numerous grades of 10 percent or more, and some very narrow bridges.

The importance of this route, paralleling the Mississippi River as it does quite closely and leading directly to Baton Rouge and New Orleans, gives obvious reason for its inclusion in the program now being carried out by the Mississippi State Highway Department with the aid of Federal

A typical bridge on Route 61—Creosoted piles and caps—20-ft. I-beam spans—Concrete deck and rail.

All Photos by Field Editor

The Piney Creek Bridge south of Natchez will have six 20-ft. and one 45-ft. I-beam spans—total length 165 ft. Footings for the main span were constructed inside coffer dams of 16 in. Jones and Laughlin sheet piling 12 ft. long. This was being pulled with a Northwest crane when the field editor came by on July 24. During construction the two holes were kept dry with a 2-in. C. H. & E. pump. This work is being done by J. W. Snowden of Natchez on a sub-contract from the Charles Weaver Company.

Ford's Creek Bridge between Natchez and Woodville, July 24, 1937. This I-beam structure has a total length of 300 ft., the three main spans resting on concrete piers founded on untreated piles. The shorter spans have cresoted pile bents. This is one of the jobs of F. V. Ragsdale Co. of Memphis, Tenn. Contract price $27,000.

Grading about 10 miles south of Vicksburg. Two Le Tourneau 12-yd carryalls pulled by Caterpillar RD8's, and one Ateco 5-yd. scraper pulled by a Caterpillar 75 move about 3,500 yds. an average distance of 800 ft. in two 7½ hour shifts. Cage Brothers of Bishop, Texas, operate this outfit.

funds. As relocated and improved, the distance from Vicksburg to Woodville is reduced to 104 miles, with maximum grades of 6 percent and no curve of more than 5 degrees. Total curvature is less than one third that of the old line. Grading measures 30 ft. between shoulders, and all bridge decks have 24 ft. clear between curbs. A high type 20 ft. pavement will be laid when fills are sufficiently settled.

All work on the improvement is by contract. Grading totals approximately 2,750,000 cu. yd. unclassified, including borrow. There is no rock on the line. In Warren County, from Vicksburg to the Big Black River, roadway excavation totals 510,000 yd., and borrow 475,000 yd. At the opposite end, the 26 miles just north of Woodville has a total of 1,250,000 yd.—an average of 48,000 per mile.

Deck Construction Moves Fast and Everybody's Happy.

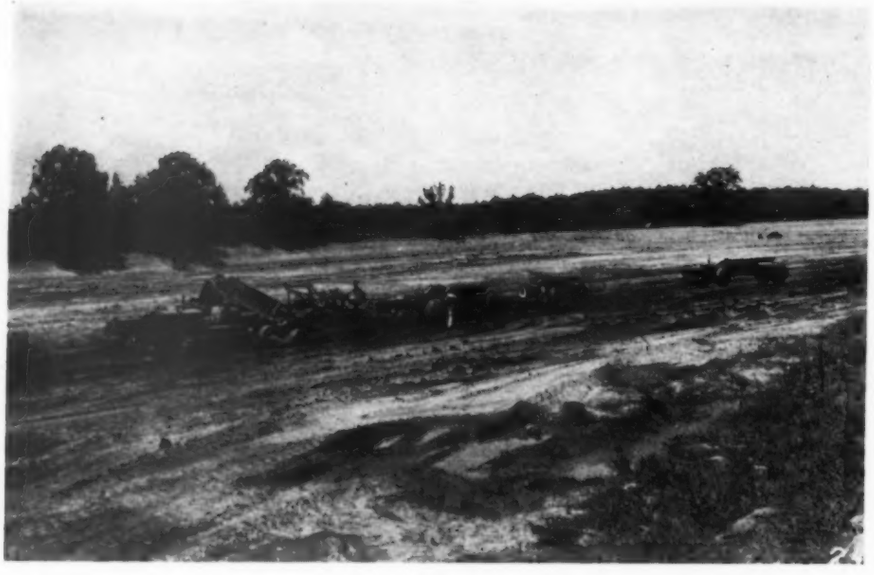
The Cantilever Spans—Pile approach at Left.

Handrail Form Work.

THREE VIEWS OF HOMOCHITO RIVER BRIDGE

Total length 3,090 ft., consisting of 250 ft. of cantilever girder main spans on concrete piers and 2,840 ft. of I-beam approach on creosoted piles. The total cost is approximately $260,000, or $84 per foot. The contractor is F. V. Ragsdale Construction Company of Memphis, Tennessee.

Many of the cuts are in the famous loess formation, which stands naturally with vertical banks. In grading, this material is cut to a ¼ to 1 slope, and where height permits is trimmed with an ordinary grader blade. Most of the borrow is in clay or sandy material. The clay cuts



This 18-acre borrow pit just north of Big Black River furnishes 240,000 yards for the approach fill. This pit is operated by Cage Brothers of Bishop, Texas. A similar pit will be opened soon by Charles Weaver Company of Jackson, Miss.

Excavating for a large box culvert on Cage Brothers' Contract south of Vicksburg. The crane is a Universal-Lorain with ½-yard bucket. A Caterpillar RD6 with Le Tourneau bulldozer, working along the line of the culvert, pushes dirt up to the dragline.

have slopes of 2 to 1. Fills over 5 ft. have 1½ to 1 slopes, whether of loess or other material. Below 5 ft. the slopes are 2 to 1, and in some cases 3 to 1.

Contract prices on excavation range from 18 cents to 23 cents per cu. yd., with an average of 22 cents (2640 ft. free haul). Overhaul averages approximately 6 cents for each ½ mile additional.

Quick-growing Bermuda grass is set out in continuous horizontal rows 4 in. wide and 12 in. edge to edge on all the flatter cut slopes. As a result of experience on other jobs, where considerable quantities dried out and died during the first few weeks after planting, a straw mulch is now used for protection. This proves effective.

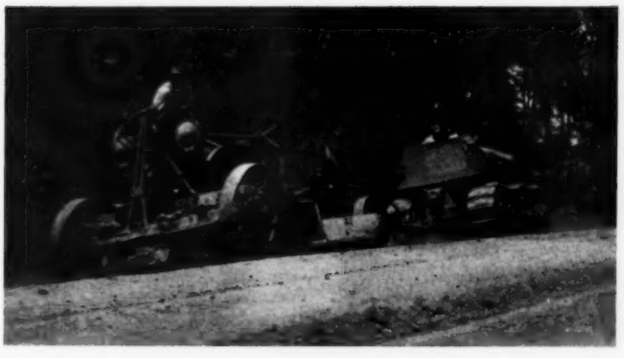
Ditch checks of grouted rubble are installed from 15 to 25 ft. apart on grades of 4.5 percent or more. They are generally 1 ft. wide and 1 ft. deep. In the loess formation the rubble is extended 1 ft. into the bank and 1 ft. above ditch level, the upper portion being mortar-finished flush with the cut slope. Ditch bottoms between checks are completely sodded. Sod ditch checks and discharge pipes are also used for erosion control.

Forms and reinforcement for a box culvert near Vicksburg. The mixer is a 105 Rex equipped with Le Roi engine. Cage Brothers' contract.

Cage Brothers' excavating and hauling outfit on the big borrow job consists of a Caterpillar elevator and tractor, and a fleet of eight Euclid Trac-Trucs of 8½ yards water measure each, but generally heaped to about 10½ yards loose measure excavated material. The crew at pit and dump averages 16 men.

At Right—
On PWS53 south of Natchez. A J. D. Adams grader does the heavy work, while a small Caterpillar trims up behind it. Caterpillar tractors pull both machines. This is on the Chas Weaver contract.

Banks are sodded with quick-growing Bermuda grass in horizontal strips 4 in. wide, with 12 in. clear space between, which will soon fill in when growing starts.



Another view on Cage Brothers' big fill. An Allis-Chalmers Model L pulling 12 ft. Blade Caterpillar.

On Cage Brothers' fill north of the Big Black River. The truck at left is returning to borrow pit.

Clearing site of approach-fill north of the Big Black Crossing. The men are taking a cable hitch on a pile of old logs and roots to be pulled out with the Caterpillar Diesel 50, of which two equipped with Le Tourneau bulldozers were engaged on this work July 23. The fill will be 1,700 ft. long and contain about 235,000 yards of borrowed material. Chas. Weaver & Co. have the contract.

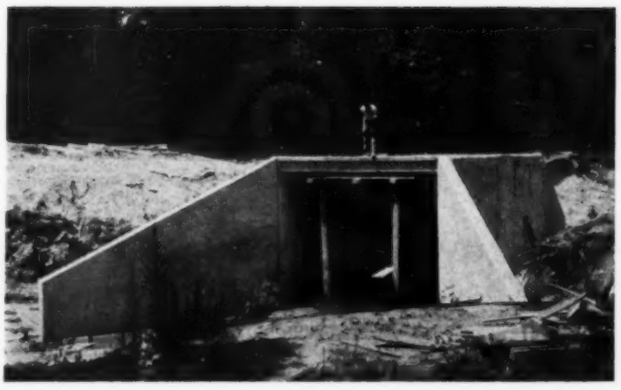
Heavy Grading on the Charles Weaver Company's Contract on PWS14 South of Natchez. Here they are working 5 Le Tourneau 12-yard carryalls in two 10-hour shifts. Caterpillar diesel 75's do the pulling. Ground is broken with a Le Tourneau gang rooter pulled by Caterpillar RD7. Leveling off is done with a Caterpillar and Le Tourneau bulldozer. About 90,000 yards was moved an average distance of 1,200 ft at this point during the two weeks just preceding this picture, in spite of considerable delay from wet weather. The foreman reports night work completely satisfactory, one 1500 watt and one 250 watt bulb, supplied from a 2000 watt Delco plant, giving all the light needed.

Numerous watercourses intersecting the route require a large amount of drainage construction, there being 29 bridges of more than 20-ft. length, all designed for an H-15 standard loading. The largest are the 3090 ft. structure over Homochito River, the 2730 ft. over the Big Black, and the 1750 ft. over Buffalo River. Timber piles, steel H section piles and concrete piers are used as circumstances dictate. All bridges have concrete decks.

Clearing up around the north approach site of Cold Creek Bridge. Ball Contracting Co., of Fayette, Miss., owns the Northwest dragline. Steel erection will begin about September first.

The bridge over Cold Creek north of Natchez will be a 210-ft. through type cantilever, with approaches of 20 ft. at one end and 80 ft. at the other. J. E. Meador & Co., of Arkdelphia, Ark., have the contract. The picture, taken July 23, shows one of the two wooden sheet pile caissons for the north pier. Concrete will extend about 10 ft. below creek bed level, and will be supported on pile footings. A Jaeger 2-in. pump keeps both holes dry.

This Pile Driver ready for work on the Big Black River approach was built by the contractor, the Vincennes Steel Company of Vincennes, Indiana, from a design by Mr. John Moon of their Engineering staff. It is equipped with an American Hoist and Derrick hoist and a 3,500-pound drop-hammer made by Vulcan Iron Works of Chicago. To the left in the picture is a crane excavating for the south abutment, and in the distance is the north tower of the construction cableway. Each cableway tower consists of a large derrick boom with guys. Such towers are easy to erect and give satisfactory service. Foundation excavation was being started July 23.



Recently Completed Box Culvert on PWS41 near Woodville. Inside dimensions 14 ft. x 12 ft. Length of box 38 ft. 0 in. Contract Cost $3,830. This culvert was built by J. W. Snowden of Natchez, Miss. under a sub-contract from Chas. Weaver & Co.

Massey Bayou is crossed by two bridges—this one with a length of 420 ft., and another of similar construction 200 ft. long. Creosoted piles in these structures range from 43 to 61 ft. Both bridges were constructed by the Halloran Company of Memphis, Tenn., under sub-contract from L. E. Harris of Dundee, Miss.

Contracts on the work are as follows—F. V. Ragsdale, Memphis, Tenn., Bridges, $372,921.30; Chas. Weaver & Co., Inc., Jackson, Miss., Grading, $540,586.00; J. E. Meador, Arkadelphia, Ark., Grading and Bridges, $101,544.45; Vincennes Steel Corp., Vincennes, Ind., Grading and Bridge, $312,132.03; Cage Bros., Bishop, Texas, Grading and Bridge, $183,728.43; T. M. Strider Co., Nashville, Tenn., Grading, $115,453.53; Ball Cont'g Co., Fayette, Miss., Grading, $177,303.31; W. L. Sharpe Cont'g Co., Memphis, Tenn., Bridge, $56,481.47.

Loess canyons are common in western Mississippi. This one was on a 4-mile connection between the old Route 61 and the new, south of Big Black River. The view gives only a suggestion of its picturesque character.

The project is under the jurisdiction of E. D. Kenna, Director; R. A. Harris, Chief Engineer, and E. B. Cavallo, Construction Engineer, Mississippi State Highway Department, Jackson, Miss. A. T. Spengler and H. M. McElroy, project engineers, with headquarters respectively at Vicksburg and Natchez, are in charge of the major part of the work.

A 28½-ft cut with ¼ to 1 slopes in the Loess in Warren County between Vicksburg and the Big Black River. Cage Brothers did this work at a price of 20c per yard.

10-Minute Method of Making Copies of Graphs, etc.

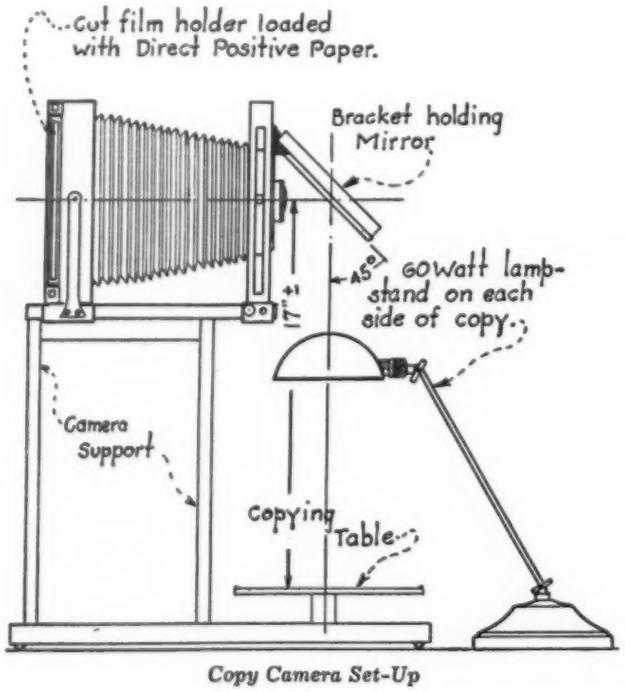
There are times in every office when it is necessary to have a letter, table, graph, or a page from a publication copied for reference. In most cases the photostatic method will furnish as many copies as is necessary, but when one or two copies are wanted at once and time is itself a factor the photostatic method is still too slow.

A system of reproducing the necessary copy in less than 10 minutes, developed at the Engineering Experiment Station of Ohio State University, is described by H. J. Hoffman, draftsman at the Station, in the June Engineering Experiment Station News.

The sketch shows the setup of the necessary apparatus which consists of a camera, preferably of the ground-glass focusing type with a small mirror mounted at 45 deg. directly in front of the lens for procuring an upright image. The mirror is the ordinary rear-vision type used in automobiles, and although a first surface mirror or a 90 deg. prism would eliminate the very faint double image, the copy is exceptionally clear and distinct. Of course the mirror is the important thing; it reverses the image and makes the copy readable. The copying table on the Station model is adjustable so that copies can be made from various sized sheets, but it would be possible to construct a much simpler apparatus with a fixed focus for the 8½ x 11 in. size only.

Both the paper and the developer are special and can be procured from the Eastman Kodak Company. The paper is what is known as direct positive paper and has a double coat of emulsion, the first coat receiving the image and acting as a negative for the second exposure which produces a positive copy. The paper is put through four separate processes in the dark room, taking about three minutes in all. As no fixing is required and as the paper is nonabsorbent, the print can be wiped dry as it comes out of the last developer ready for use.

No special lighting is necessary, two 60-watt lamps in ordinary desk stands being sufficient to illuminate the material being copied. The exposure time will vary in relation to the type of lens, light intensity, etc., but it must be remembered that a finished print that is too dark does not indicate overexposure but rather the opposite, or underexposure. Cut-and-try timing of the exposure is suggested for those who set up their own equipment.



Copy Camera Set-Up

Railway Crossing Protection

RAILWAY crossing accidents happen at widely scattered places,—a surprisingly large number at minor crossings. They are not concentrated in a few important crossings where they can be eliminated by separation of grades or by elaborate protective systems, but as a practical matter there must still be a considerable reliance upon the simpler forms, such as fixed signs.

It is difficult to measure the relative efficiency of crossing protection. Accident statistics alone are not a reliable guide, they do not show differences in conditions at the various crossings, and are greatly affected by chance. Possibly the best criterion of efficiency is the degree to which any type of crossing protection is successful in deterring people from going into a situation of hazard. An interesting paper dealing with the efficiency of various types of railroad crossing protection was presented at the 1937 Annual Highway Conference at the University of Michigan by Warren Henry, Assistant Chief Engineer, Illinois Commerce Commission. A summary of his paper follows.

Series of observations of a typical crossing in Springfield, Ill., covering several months, showed that about 50 per cent of the automobile drivers treated a flashing light signal as merely an informational, not as a mandatory warning, and that about 5 per cent chose to go into actual danger by crossing over with the train 10 seconds or less away. About 2 per cent did so with the train 5 seconds or less away.

Flashing light signals are highly developed mechanically and very reliable. The greatest factor in their efficiency is not in the apparatus but in the user.. This can be greatly improved by cooperation of the public authorities. It is a public matter because those who collide with trains at railroad crossings necessarily endanger, and frequently kill and injure others than themselves. Everyone on the train is in danger, as trains are rather frequently derailed and wrecked by collisions with automobiles and trucks.

The flashing light signal is not self-enforcing, the hazard of the train alone is not sufficient to deter a minority of drivers from taking a chance they should not take. This type of signal is not especially efficient in meeting the situation which arises when two trains pass each other near a grade crossing.

Some of the more modern barrier types of protection especially the automatic gate, and a recently introduced combination of gate arm with flashing light signals appear to have a self-enforcing characteristic, also to be almost impossible to overlook, and furthermore to meet the two train situation. These, however, are probably not as widely useable as the flashing light signal.

There is no panacea, no single type of crossing protection which should supplant all others. Progess should be along the line of developing full efficiency from each of these types.

IMPORTANT UINTAH BASIN HIGHWAY GIVEN OIL MAT SURFACE

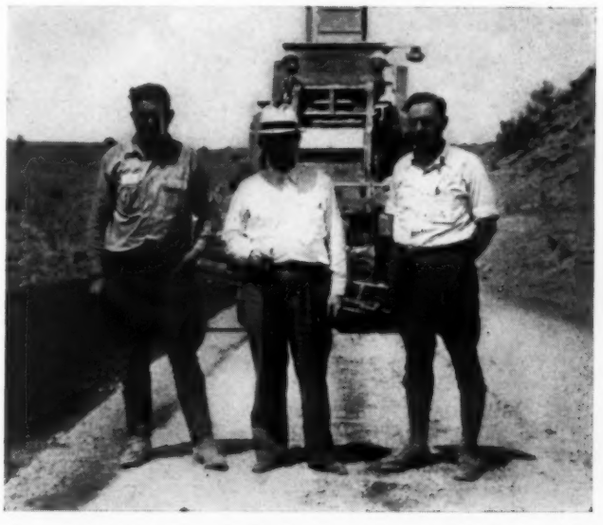
No Railroad Service for Large Area

By CORNELL CLYDE

Superintendent W. W. Clyde & Co., Contractors, Springfield, Utah

IF one would get a road map of the United States or of Utah and draw a pencil line along U.S. 30 from the central part of Wyoming to Salt Lake City and another pencil line from Western Colorado to Salt Lake City, one would have sketched approximately the lines of two adjacent railroads and at the same time have marked the approximate edges of the Uintah Basin, Utah. In this area is the town of Vernal which claims to be the biggest town in the United States over 125 miles from a railroad point.

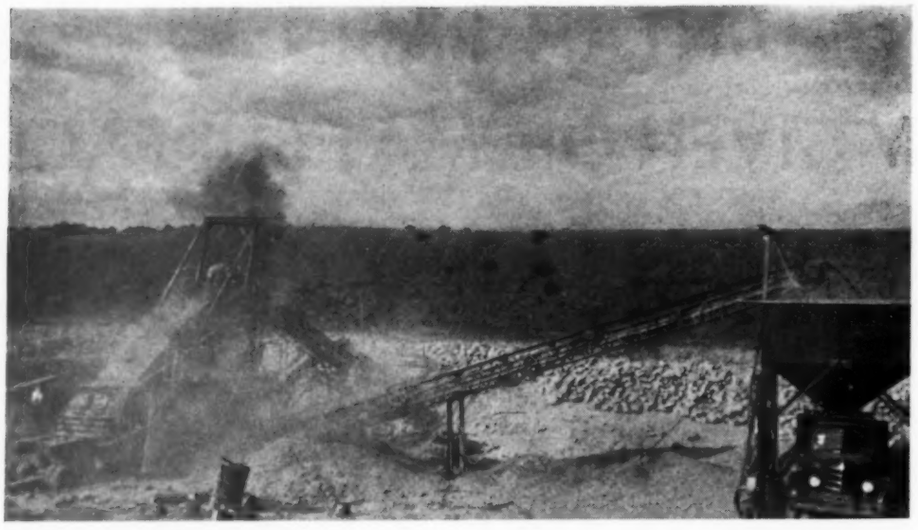
Vernal is on U.S. 40, which highway traverses about the center of the Basin. Benches and mountains entirely surround this large area in northeastern Utah. Settlers have spent about a generation developing the irrigable areas that exist at present; the section was opened to homestead in 1905. Just north of Duchesne is a 20,000 acre tract that could be developed by irrigation for raising sugar beets if cheap transportation could be made available. During all this development period, U.S. 40 has made progress in construction but has lagged behind U.S. 30 and U.S. 50. Highway 40 is the only means of communication and for source of supplies for the population of the Uintah Basin.



Superintendent Cornell Clyde, V. J. Brown, Publishing Director of ROADS AND STREETS *and R. W. Griffin, Resident Engineer, Utah State Highway Commission, Discuss the Importance of Surfacing U.S. 40.*

The road is mostly surfaced now with bituminous surfacings of various types, including fluxed Gilsonite and natural rock asphalt, except about 30 miles which is expected to be completed next year.

Engineers Checking Cross-sectional Area of Windrow for Barber Greene Traveling Mixing Plant on U.S. 40 near Fruitland, Utah. W. W. Clyde & Co., Springville, Utah, Contractor.



Universal Portable Crushing and Screening plant in operation, preparing 80 tons per hr. for U.S. 40 near Fruitland, Utah. W. W. Clyde & Co., contractors.

Universal Portable Gravel Plant at work in the Roadside Pit. A Caterpillar Tractor With Le Tourneau Bulldozer Feeds the Hopper. A 1300 Caterpillar Diesel Portable Power Unit Furnishes Power.

On a 15.519 mile stretch of this important road about 20 miles west of Duchesne, near Fruitland, we are doing a surfacing job, including placing of gravel. Graveling is placed as follows:

Base—4 inches of gravel that passes a 3-inch square screen and is retained on ⅞ inch screen.

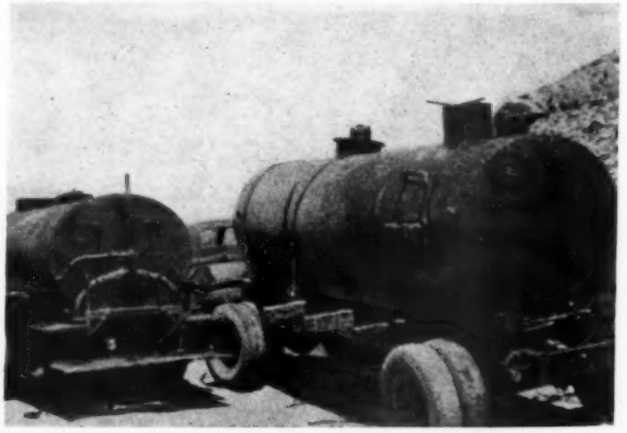
Second course—3 inches of gravel from ⅞ inches down. The purpose of this course is to cover the coarse stones of the base.

Third course—3 inches of gravel from ⅞ inches down. This latter course while spread out at first, is later windrowed to be used for oil mat and shouldering.

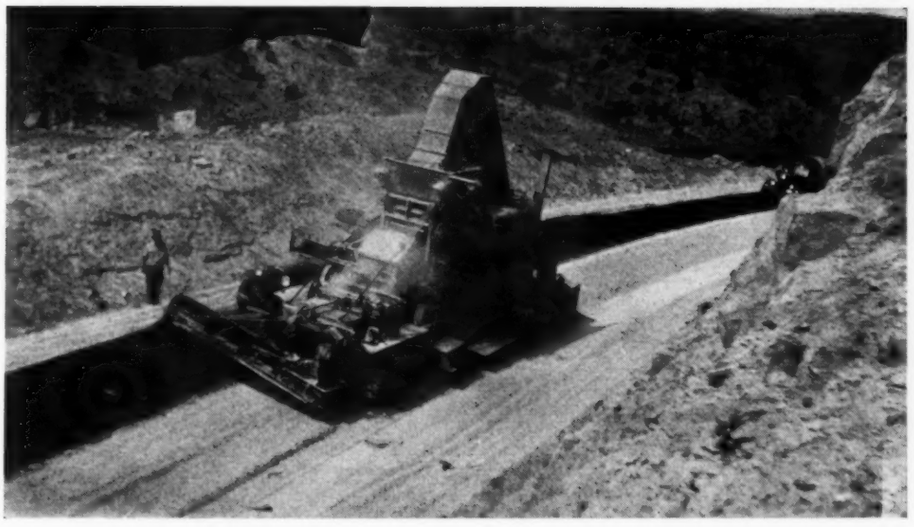
This makes a total of 10 inches of surfacing, of which the top 2½ inches will be an oil mat.

Gravel Production

For this contract, suitable gravel was found right along the road. We set up a complete portable crushing and screening plant to produce the graded aggregate specified. The plant was set down into the pit about 8 feet on the edge of the gravel deposit. A Diesel tractor equipped with a bulldozer pushes the gravel onto a grizzly which separates out rock over 9 inches in size. The rest is fed through the jaw and roll crushers and conveyed up into a storage bin from which a fleet of trucks haul the gravel onto the road. The portable plant operates about 20 hours a day and produces on the average about 80 tons of gravel per hour, passing a ⅞ in. square screen. An indication of the hardness of the rock is obtained by noting that less than .3 percent of bitumen is absorbed. Screen tests of the gravel are run every 500 feet and extraction tests on the mixed material are made every 1000 ft. The state maintains a portable laboratory on the job and an inspector on the mixing operations.



Semi-Trailer Loads Distributor on Surfacing of U.S. 40 near Fruitland, Utah.

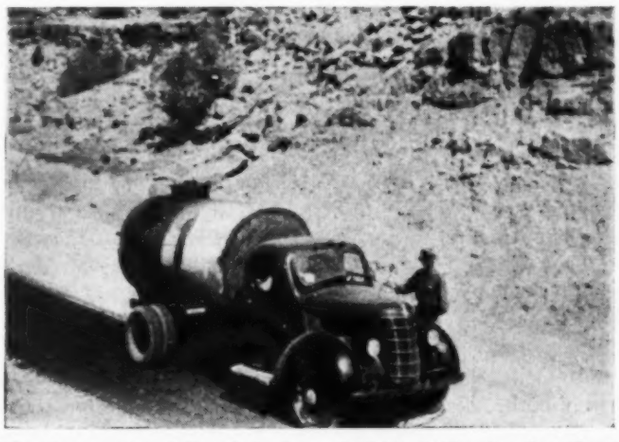


Barber-Greene Traveling Bituminous Mixer Proportions and Mixes the Aggregate and Asphaltic Oil from Utah Oil Co.

Caterpillar Diesel Motor Patrols Turnover and Spread Finished Mixture.

Oiling

As the surfacing operations proceed the top 3 inches of gravel is windrowed to one half of the road. The cross-sectional area of the windrow must be 5.8 sq. ft. to give the necessary 2½ inches of compacted oiled mat. The exposed half of the sub-gravel course is primed with a tack coat of SC-1A liquid asphalt at the rate of .25 gal. per sq. yd. After the mixing plant has passed, the other half of the road is primed.



This International Truck is One of 10 Tank Trucks that Haul the Oil 115 miles from the Refinery at Salt Lake City.

Approximately 4½ percent of asphaltic oil is used in the mix. The rate is varied by the inspector according to the gravel gradation. The mixture leaves the plant as a windrow on the opposite half of the road from which the gravel windrow was picked up. Utah State Highway commission engineers require this windrow to be turned over two or three times with a motor grader or blade before it is spread and rolled.

Oil is hauled from the refinery at Salt Lake City in tank trucks, an average of 115 miles to the job. To keep a steady flow of oil 10 tank trucks are required to shuttle over this long haul. After the motor graders spread the mixture to a 20 foot width, with a 1½-inch thickened edge, the surface is compacted with an 8-ton tandem roller. Finishing operations consist of pushing the small windrows of gravel, left on each side of the surface, onto the shoulders. Finally, a seal coat of .15 gal. per sq. yd. of RC-1 oil is applied but no sand or fine aggregate is spread.

Quantities

The crushing and screening plant averages approximately 80 tons of ⅞ in. gravel per hour. It works 20 hours a day. We are paid 60 cents per ton in place and each load is scaled on the way out from the pit. We estimate that 3000 gal. per mile of tack coat is required

Austin-Western 8-Ton Tandem Roller Compacting Finished Mix. Small Windrows on the Side Left for Spreading on Shoulder.

for which we are paid $3.20 per bbl., applied. The seal coat application is paid for at the rate of $4.50 per bbl., applied. About 18,000 gal. of the mixing oil is required per mile for which we are paid $3.20 per bbl. measured at the mixing plant. We endeavor to work a 10-hour day but oil supply governs this. Some days we use 15,000 gal. and other days, less, due to delays because of long oil haul and to weather conditions. Mixing, laying and finishing is paid for at the rate of $650.00 per mile.

Equipment

For handling the job we have the following equipment:

1—Complete Universal portable gravel plant with 9 in. by 36 in. jaw crusher and 16 in. roller crusher. Driven by 1300 Diesel Caterpillar power unit.

13—Gravel hauling trucks:

- 5—White No. 704 trucks hauling 6 tons per load.
- 1—GMC 3-ton truck hauling 6 tons per load.
- 3—Ford trucks hauling 5 tons per load.
- 3—International C-40 trucks hauling 6 tons per load.
- 1—Chevrolet truck hauling 5 tons per load.

1—Barber Greene traveling bituminous mixing plant.

2—Caterpillar motor graders:

- 1—No. 11 single drive gas unit.
- 1—No. 11 tandem drive Diesel unit.

1—Austin-Western 1000 gal. distributor.

1—Austin-Western 8-ton tandem roller.

10—Shuttle trucks for hauling oil:

- 1—Dodge semi-trailer—2300 gal. tank.
- 1—International—2000 gal. tank.
- 3—International—1300 gal. tank.
- 1—International—1600 gal. tank.
- 1—Chrevrolet—1300 gal. tank.
- 3—Fords—1300 gal. tank.

Oil is obtained from the Utah Oil Co., Salt Lake City.

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New Highway Safety Organization in Indiana

Among new incorporations in the month of July was the Indiana State Highway Safety Campaign, Inc., 2101 E. Washington St., Indianapolis, Ind.; resident agent, Maurice Bernard, 2101 E. Washington St., Indianapolis. The organization has no capital stock. Its purpose is to promote safety on the highways of the State of Indiana. Maurice Bernard, D. Fred Shannon, and David B. Goldman were the incorporators.

A Correspondent Suggests Advance Warning Signals at Highway-Railroad Grade Crossings

To the Editor:

The Federal Government program of the past few years for reducing the number of accidents at railroad grade crossings, by elimination or crossing signal protection, has raised some interesting questions among highway officials. The most interesting of which is probably what constitutes ample protection, where elimination is not possible, and where crossing signals are to be considered.

The standard railroad flashing light indication is undoubtedly the finest warning that can be placed at the crossing. However, because of slippery roads due to ice, snow, sleet or rain; insufficient approach warning due to curves, buildings, etc.; weather conditions such as fog, rain, snowstorms, etc., it is believed the signal at the crossing should be supplemented by a continuously flashed, yellow, advance warning signal.

Accident statistics have shown an all too high percentage where autoists run into the sides of trains. This would seem to indicate the lack of sufficient warning for proper control of the car before reaching the crossing.

Advance warning signals are recognized as necessary in railroad and traffic signaling. Their extension to crossing signaling where the hazard is even greater, would offer motorists the same double type of warning indication now given to engineers on trains. Train safety is paramount, and their safety records prove the desirability of advance or caution signals.

Installations of advance warning signals would undoubtedly be approved by the Bureau of Public Roads on Federal Aid programs if the principle of advance warnings is conceded to be correct.

Maintenance of these signals would, of necessity, be a state problem, as these signals would be located several hundred feet from the crossing. The maintenance expense, however, would be insignificant to the safety feature involved in this type of indication.

W. J. Savage.

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McLaughlin Now Michigan Research and Testing Engineer

J. W. Kushing, research and testing engineer of the Michigan State Highway Department since 1933, has resigned to become vice-president in charge of engineering for Highway Steel Products Co., of Chicago Heights, Ill. His assistant, William W. McLaughlin, has been promoted to acting research and testing engineer. E. A. Finney, assistant professor of civil engineering at Michigan State College, will be McLaughlin's assistant. The changes are effective July 1. McLaughlin has been with the department for four years. A graduate of Michigan College of Mining and Technology and a native of Muskegon, he was with the Detroit Water Board for ten years prior to his connection with the state highway department. Mr. Finney has been on the Michigan State College faculty for twelve years and holds degrees from both Allegheny College, Pennsylvania, and Iowa State College. Much of his time at M.S.C. has been devoted to research for the experiment station.

Roads—With 38,239 Projects—Lead All WPA Activities

THE grand total of all projects placed in operation by the Works Progress Administration as of Dec. 31, 1936, was 121,240. This figure represents all work begun during the 18 months of the WPA's operations from the summer of 1935 to the close of 1936. During the same period, projects to the number of 73,146 were completed. Work continued in progress at the close of the year on 48,094 projects. Many of these have since been completed, accomplishment figures not yet being available. At the same time, other hundreds of new projects have been initiated since Jan. 1, 1937, on which work is now in progress. Complete reports on the total of these new projects also are not yet available from the states. During this period, employment on these projects totalled 2,500,000 persons as a monthly average, with the peak of employment at 3,035,852 persons in February 1936. In December 1936, 2,192,409 persons were employed on WPA projects them in operation. In May 1936, employment had dropped to 2,016,979 persons.

Of the 121,240 projects representing the grand total, 85,011 or 77.3 percent involved construction work and 36,229 or 22.7 percent embraced non-construction types of work. Among the 85,011 construction projects, 41,037 represent new construction and 43,974 were and are devoted to repairs and improvements. Work had been completed on 25,971 new construction projects as of Dec. 31, 1936, while new construction projects continuing in operation numbered 15,066. On the same date, 29,369 repair and improvement projects had been completed while work continued in progress on 14,605 such undertakings. These figures do not take into account either completions or new projects initiated in 1937.

Completions reported in the total of 36,229 non-construction initiated prior to Dec. 31, 1936, numbered 17,806 while those still in progress totalled 18,423. As in the case of construction projects, many of the non-construction projects listed as operative since have been completed while the early months of 1937 saw the initiation of hundreds of new undertakings.

Among the WPA construction activities, projects devoted to highways, roads and streets constitute by far the largest number with a total of 38,239. Of these, 14,170 represent new construction and 24,069 repairs and improvements. New construction projects in this category to the number of 9,424 had been completed at the close of 1936, while 4,746 continued active. Repair and improvement projects which had been completed numbered 15,405 and 8,664 continued in operation. Of the total of 24,829 completed projects involving highways, roads and streets, 10,164 dealt with farm-to-market and other secondary roads; 233 involved primary highways; 5,556 composed operations on streets and alleys; 2,019 were for installation or repair of sidewalks, curbs, and paths; while 1,990 were for roadside improvements, 1,471 for bridges and viaducts, 14 for grade crossing eliminations, and 3,382 for other types of road and street work. Of the 13,410 projects in this classification still in progress, 6,013 were farm-to-market road projects. Of the balance, 177 involved primary highways; 2,529, streets and alleys; 786, sidewalks, curbs and paths; 752, roadside improvements; 516, bridges and viaducts; three grade crossing eliminations; and 2,634, miscellaneous work on roads and streets.

With the WPA road construction program in full swing, more than 700,000 persons of the total given employment have been at work on road projects. More than 120,000 miles of highways, roads and streets have been constructed, repaired and improved by the Works Progress Administration with this army of laborers, who were taken from the relief rolls. Based upon the latest reports available from the state WPA offices, the following figures reveal the accomplishments of this vast labor force on highways, roads, streets, and related projects:

Bituminous or concrete roads, 2,454 miles new construction and 3,813 miles repaired or improved.

Brick or block roads, 267 miles new construction and 568 miles repaired or improved.

Dirt, clay, or gravel roads, 22,765 miles new construction and 61,453 miles repaired or improved.

Improvement of roads, 3,658 miles new construction and 27,614 miles repaired.

Road shoulders, 1,555 miles new construction and 18,838 miles repaired or improved.

Grade-crossing eliminations by relocation, 16 involving construction of 26 miles of roads.

Grade-crossing eliminations by construction of viaducts, six.

Bridges, 7,633 new construction and 12,953 repaired or improved.

Culverts, 85,811 new construction and 26,541 repaired or improved.

Sidewalks and paths, 2,540 miles of new construction and 1,972 miles repaired or improved.

Curbs and gutters, 7,936,922 feet of new construction and 3,721,208 feet repaired or improved, equipping 2,022 miles of roads and streets.

Roadside landscaping involving 8,731 miles of road and 25,702 acres of roadside.

Guardrails and guardwalls, 1,881,833 feet of new construction equipping 1,256 miles of road, and 1,997,547 feet of repairs or improvements equipping 799 miles of roads.

Lights for roads and streets, 3,007 new installations serving 61 miles of road, and 5,860 repaired or improved serving 309 miles of roads and streets.

Fire trails, 658 miles new construction and 777 miles repaired or improved.

Other major classifications in the construction category of WPA operations include 19,254 public building projects with 12,874 completions and 6,380 active; 7,667 projects devoted to parks, fair grounds and other recreational facilities with 4,946 completions and 2,721 active; 11,489 projects relating to sewer and water systems and other utilities with 8,086 completions and 3,403 active; 1,094 airport and other transportation projects with 573 completions and 521 active.

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Rubber Pavement Trial in Russia—A recent dispatch to the U.S. Department of Commerce states that for some months a pavement of black and brown rubber has been under test at the entrance to a large Moscow plant, where traffic is very heavy. The experiment has been declared successful after 9 months, during which the pavement has carried thousands of trucks and wagons, and even track-laying tractors run for a whole night. This pavement is noiseless and it is said that in winter neither snow or ice remain on it, and it is easy to clean and wash. The Moscow City Council is now negotiating for the laying of rubber pavements in one of the large sections of the city.

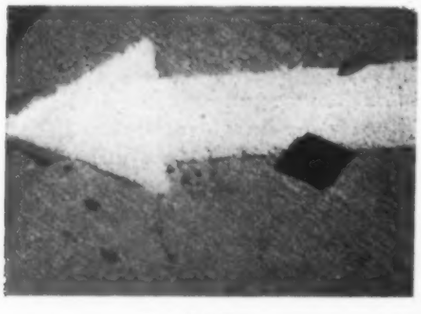
OBSERVATIONS BY THE WAY

By A. PUDDLE JUMPER

¶ California has a good idea, in fact, many good ideas, incorporated along their highways. I noticed one thing in particular, that is a good protection to the high fills. A low dike is built out of bituminous mixed gravel or bituminized natural soil along the edge of the fill and shoulder of the road. The dike varies from 10 in. to 16 in. in height and from 6 in. to 12 in. in width on top with a trapezoidal cross section. These are on grades and keep storm waters from running off except at the provided outlets. The shoulders of the road are also bituminized at these places.

• •

¶ The highway on the west edge of Los Angeles, California, toward Riverside is four lanes wide with a center strip about 6 feet wide. To keep traffic separated, several kinds of markers and methods are being tried. The arrows are built up out of asphalt coated chips about ¾ in. high and painted white. The piles in the center are built of oiled gravel. Other arrows are just painted on the paving. Note the width of the painted traffic lines. Some of these danger zone markers are black rectangles of various shapes as shown.



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¶ As shown by the accompanying picture, the State Highway Department of California, has painted wiggly traffic lines to warn motorists of dangerous intersections or bad curves. I heard quite a lot of favorable comment on this type of marking. At night, and particularly in rain or fog, these markings are far better warning schemes than roadside signs.

• •

¶ I certainly was provoked when I crossed from Arizona into California. I was stopped on the border and all my luggage and baggage opened and inspected. Unfortunately, I had a dirty shirt in one part of my Gladstone bag. I wonder what kind of an impression it left on the inspector. It was much easier for me to cross into Canada and into Mexico when I visited those countries, than it was for me to visit the Principality of California. I thought California was a part of the United States. One would think it a foreign country, so rigid was the inspection. After the inspection of baggage, I was ordered to park over to one side—so was everybody else that came through—and go into the office where questions were asked and credentials required before I could proceed. Finally, a windshield sticker was written up and I was told I could stay in California until the end of this year. I got by easy, too, compared with one man in the office. I have wondered since, what would have been the result if I had not made a mistake and brought my state registration card along in my pocket. The inspector asked me what my address would be. Having survived the "going over" that far, I picked a number and street name out of the air and told it to him. Again, I wonder what the result would have been had I stumbled over this question or had admitted I had *no address*. The irritation of this interference with my peaceable travel combined with the 100 degrees California desert heat started me off with a very unpleasant feeling toward the Principality of California.

• •

¶ On the street leading south out of Las Cruces, New Mexico, traffic lane separation is definitely effective—an elevated irrigation ditch takes up the area between the traffic lanes. The accompanying picture shows this.

• •

¶ Texas is developing a nice idea regarding road signs as shown by an accompanying picture. Back of every sign is a shrub or plant native to the territory. It forms a good background for the sign to oncoming traffic, at the same time, shielding the back of the sign from view to traffic to which it does not pertain.

¶ To beat the state rules on truck sizes and weights, manufacturers are sawing off a limb on which they are sitting. States set up laws and regulations to govern sizes and weights for the protection of truck operators. State highway engineers know the capacities of their bridges much better than do truck manufacturers and operators. Yet operators scheme to devise ways and means of increasing their loads (and overloads) and manufacturers build what they want. Rotten foresight!

• •

¶ Type of sign used on highway of northern Mexico. Note map above sign at junction between Agua Caliente and Tia Juana.

¶ Herewith is a picture of an outfit of Oswald Co., Contractors, Los Angeles, California, which I saw working just west out of Los Angeles. The first unit is a Best tractor; the second is an Adams grader with turnover blades attached for building a windrow out of gravel on which asphaltic oil had been applied; the third unit is a Gardner roadmix pugmill unit attached to an Adams grader frame.

This latter unit mixes the windrow, left by the second unit, by a revolving blade and spreads the mixture out back of the machine. An Adams motor grader finishes the oiled shoulder which is rolled by an Austin-Western 8-ton tandem roller.

• •

¶ On U.S. 85 between Sorroco, N.M. and Sante Fe, storms did an immense amount of damage the last of June.

Accompanying pictures show some of the tons of gravel washed down the arroyos and gullies from the mesas

and hills on to the roadway. The bus shown in one picture is just able to get past washed out roadways and

over heaps of debris. Another picture shows where the road washed out

three feet deep and a hundred feet wide. A drill rig got stuck among the boulders washed down.

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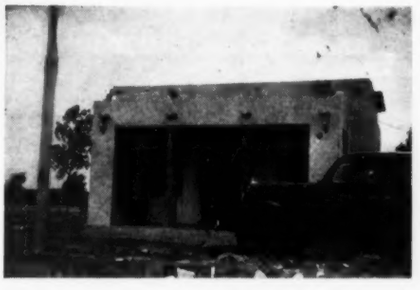
¶ This neat state highway department road-information station was just across the Texas line from New Mexico between Los Cruces, N.M. and



El Paso, Tex. A courteous, uniformed attendant was ready for whatever service he could render. California, take note.

• •

¶ In some highway cuts near Indio, California, I noticed the cut slopes were coated with bitumen. The road was cut through sand dunes or sand hills and the bitumen, asphalt I believe, was sprayed on the backslope clear to the top of the cut. Footmarks in some places had broken the coating but it was holding well just the same.

• •

¶ One of the most scenic mountain roads I've ever traveled is between Silverton and Ouray, Colo. An accompanying picture shows the canyon and a guard rail along one of the precipitous gorges.

TRAILER INDUSTRY PREDICTIONS ARE THAT NEARLY 100,000 NEW HOUSE TRAILERS WILL HAVE BEEN PRODUCED BY THE END OF THIS YEAR.

ROAD BUILDERS'

AUGUST, 1937 AMERICAN ROAD BUILDERS'

FIVE-STAR ROAD SHOW

Down the Road

By CHARLES M. UPHAM

Engineer-Director,
American Road Builders' Association

GOOD ROADS AND GOOD LIVING

A road can make or break a man. It wields a tremendous influence in his life. It carries him forward, if it is a good road, to success and the attainment of a happy and well-rounded life. It bogs him down, if it is a bad road, and he drops far behind his neighbors in the pursuit of a better life; it retards his ambitions and decreases his usefulness, it mires his ability to earn and lowers his standard of living.

A few months ago in the post office of a small North Carolina town I ran across two young men that I had not seen in a long time. I had met them and their farmer fathers eleven years ago on a trip through the state as highway engineer. Although these young men live only a few miles apart, the farm on which each was born and brought up has its own secondary-road access to the main highway that leads to town and the world beyond. One of these secondary roads is a good road, properly constructed and periodically maintained. The other is a deplorable collection of ruts that would not justify the name of cowpath. The same condition existed eleven years ago.

The two young men came into the post office separately. As I talked to the first one, I learned that he was a college graduate with special training in journalism. He told me of plans to publish the town's first weekly newspaper. He was eager, well-spoken and forceful. He is the son of the farmer who lives on the good secondary road.

The other young man was awkward and unimpressive when I talked to him. He was embarrassed at his lack of conversational ability. I asked him what he was doing and he said, "Nothing much, I guess." He did not get to finish grammar school. He is in a rut and has no destination. He is the son of the farmer who lives on the bad secondary road. He is the product of eleven wasted years that can only be blamed on the unpardonable condition of a road that has continued to keep him isolated from the good things of life. His is the pitiful story of a boy deprived of schooling by the impassability of the road in front of his home that prevented the school bus from picking him up and carrying him with the other children to the centralized school fifteen miles away. His is the sad tale of a young man without funds to obtain outside education in the form of profession or trade because a bad road has continued to defeat his father's efforts to get his produce to a market, comparatively speaking, only a stone's throw away.

The question today is the same as it was eleven years ago. Do our lawmakers unmistakably realize that they legislate a better life for their fellowmen, their own neighbors and their neighbors' children, when they legislate money for the construction and maintenance of good roads under proper administrative expenditure? Have they been convinced that good roads bring about good living conditions?

UNPRECEDENTED EXHIBIT SPACE RESERVATIONS

The demand for "choice seats" for the five all-day performances of 1938's FIVE-STAR production, to be staged by the American Road Builders' Association in Cleveland's Public Auditorium next January 17-21, far exceeds the demand for "tickets" of any other Road Show year.

"I have every reason to believe," said Charles M. Upham, Engineer-Director of the A.R.B.A., "that our 1938 Road Show, with its thousands of lightweight and heavyweight informative exhibits, is going to be the first massive demonstration of its kind to completely fill the Cleveland Public Auditorium and its expansive exhibit halls in the fifteen-year history of the building."

Printed application blanks for exhibit space reservations were mailed out in July by the American Road Builders' Association, but a full month before that time the executive offices of the organization in Washington, D. C., were receiving on the average of two request letters a day from exhibitors seeking advance Road Show floor-space reservations. This is only August, with January, 1938, and the Cleveland Road Show and Convention still five months away.

Exhibitors know that the demand for space at the A.R.B.A.'s "Grand Slam" Road Show is going to bring about an early "sellout" of choice locations. That's why A.R.B.A. mails get heavier every day with added exhibit space reservations. That's why the 1938 Road Show and Convention of the American Road Builders' Association is going to be called the "Five-Star Fashion Show" of the highway world!

REVIEW

GROWTH OF MOTOR TRUCK TRANSPORTATION OVER THE NATION'S HIGHWAYS INDICATED BY THE USE OF 4,020,000 UNITS LAST YEAR.

ASSOCIATION—WASHINGTON **AUGUST, 1937**

HEADS FOR "SELLOUT"

HIGHWAY ACCIDENT ANALYSIS BEGUN BY A.R.B.A. COMMITTEE

Project Number One of the Problem Committee on Analysis of Accident Records, a subcommittee of the American Road Builders' Association's Committee on Safe Highways of which Dr. H. E. Tabler, chairman of Maryland's State Roads Commission, is general chairman, will be the collection and analysis of accident data and traffic facts concerning fifty accident-prone locations throughout the nation.

"The purpose of this project," said Harold F. Hammond, traffic engineer of the National Bureau of Casualty and Surety Underwriters and chairman of the accident analysis committee, "is to show that the highway, if not properly designed and maintained, is a direct cause of motor-vehicle accidents. Each member of our committee has been asked to furnish as many examples of accident-prone locations as possible. To reach a quota of fifty studies, each committee member will have to turn in not less than five. Accident-prone locations may be steep hills, short and blind curves, narrow bridges, crowned roads, slippery roads, narrow roads, peculiarly shaped intersections, bottle necks and inadequate shoulders. The length of the location may be anything from 100 feet to ten miles. Committee members have been urged to supply different types of examples so our report will not lean too heavily on any one type of accident-prone location. We are trying, first of all, to show types of highway conditions at locations that create accidents rather than the frequency of such locations."

Data and facts to be collected by this problem group of the Committee on Safe Highways of the American Road Builders' Association will include the following information:

HAROLD F. HAMMOND

1. *COLLISION DIAGRAM.* This diagram will show all the motor-vehicle accidents for some given period of time—preferably twelve months or more. Six months' experience will be considered satisfactory if it is sufficient to be convincing. Each accident pictured on the collision diagram will include the date, time, weather and road condition, but the accidents on the diagram may also be keyed to show other pertinent information which will help to show that the road was a direct or indirect cause of the accidents.

2. *ACCIDENT SUMMARY.* A short summary of the accident experiences to help explain the collision diagram.

3. *LOCATION SKETCH.* No collision diagram is complete without a scale drawing and a description of the location. A blueprint of the location and a photograph, if possible, will accompany the collision diagram. All the design features that might have contributed to the accidents are to be included on the blueprint or shown in the photograph. A description of the location will be considered satisfactory if it is impossible to obtain a blueprint or a photograph.

4. *MOTOR-VEHICLE VOLUME.* A count of motor-vehicle volume at each location will be obtained.

5. *MOTOR-VEHICLE SPEED.* A speed check will be included if possible. If none is available, a description of the types of vehicles using the highway and an estimation of the speed are to be used instead.

In an attempt to present a more instructive and convincing report, illustrations will be used wherever possible. The A.R.B.A. accident analysis is anxious to obtain the complete story of accident-prone locations that have been corrected through a change or improvement in highway design.

NORTH DAKOTA HIGHWAY CONTRACTORS VOTE A.R.B.A. AFFILIATION

The North Dakota Highway Contractors' Association at its meeting in Jamestown, N. D., Monday, July 12, voted affiliation with the American Road Builders' Association. Miss Mary K. Nierling, secretary-treasurer, W. H. Noel Co., Inc., Jamestown, is president of the North Dakota group and Milton Rue, president of Rue Construction Co., Bismarck, is vice-president. The North Dakota Highway Contractors' Association represents 25 contracting firms.

THE MANAGEMENT OF HIGHWAY GRADING

The Second of a Series of Articles Dealing With Its Economic Aspects

By J. L. HARRISON

Senior Highway Engineer, U.S. Bureau of Public Roads, Washington, D.C.

Unless Otherwise Indicated All Pictures Are by Courtesy of the Bureau of Public Roads

Chapter 2—The Type of Equipment to Be Selected.

IN THE first article of this series it was pointed out that the first consideration in selecting an outfit is the matter of its size—that is of the investment that owning it will involve—the nub of the matter being that the cost of a modern grading outfit is so great, and the margin of profit in grading work so narrow, that the extra ownership expense an overlarge outfit involves is certain to absorb profit and in many cases has so reduced current assets that the volume of work which could safely be taken was adversely affected.

Considerations Affecting Choice of Outfit

The next matter it is desirable to consider is the type of outfit to own. There are large areas in this country in which there is little or no rock to be handled. In other regions there is a good deal of rock on some projects with little or none on others. There are also areas of considerable size in which practically all of the work offered includes a considerable fraction of rock work. Rough country introduces such special considerations as deep cuts and high fills. Design policies influence the length of haul, the width of cuts and fills, gradients, etc., all of which have some bearing on the character of the work and correspondingly on the kind of an outfit it is desirable to own.

The power shovel is the most versatile tool used in the grading field. It can be operated over almost any type of ground. It will handle almost any sort of material from the best common excavation to poorly broken rock. It is rugged and dependable. It will work with almost equal efficiency in short cuts and in long ones—where the cutting is deep and where it is shallow. Ordinarily it is readily convertible into a dragline or into a crane if the demand is for a unit of one of these types.

The elevating grader is not a versatile tool. Developed on the prairies of the middle west it is primarily a prairie tool—efficient in handling common excavation in rolling country—but a tool not as well adapted to use in rough country or where cuts are short. It is not capable of handling shale or rock, it does not handle sand or gravel too well, and is not adapted to miscellaneous odd digging jobs. In short it is a one purpose unit, but for this purpose it is a highly efficient unit.

The modern tractor-drawn large scrapers are rugged, well built units, somewhat more adaptable than elevating graders, less adaptable than power shovels. They work well in all sorts of good common excavation whether found in rough, in lightly rolling, or in flat country. Whatever they can load they can carry. They can, therefore, handle almost any sort of material from light sand to soft shale. They will take well shot shale and even well shot rock if it lies so that it can be loaded and the pieces are not so large that they interfere with proper dumping. Good common is the natural field for these units.

From this brief summary of the fields in which these units ordinarily are used, it is apparent that the first choice lies between the selection of a universal unit and one having less versatility. This, in practice, means that a contractor who owns a power shovel is equipped to handle almost any type of grading work that may be offered—that is, that the physical characteristics of the job are most unlikely of themselves, to preclude a bid on it.

If an elevating grader outfit is selected and, to a lesser extent, if a large scraper outfit is selected, the physical conditions each job presents must, thereafter, be considered with some care as it is desirable only to take work of a character these units are adapted to handle.

These are matters contractors are accustomed to giving some thought as is evidenced by various facts of which no one is, perhaps, more conspicuous than that the elevating grader is all but an unknown unit in many regions though on a good many jobs in most of these regions elevating graders would evidently have proved both satisfactory and economical. The reason so few such units are found in these regions lies in the fact that the percentage of projects on which they can be used to advantage is relatively small. That is, the contractor who owns such an outfit must thereafter confine his bidding to offers on this relatively small fraction of the work available. Few men like to work on as restricted a basis as this and few attempt to do so in spite of the fact that, normally, there is more certain profit in narrow specialization than is to be had by taking part in the more active competition, work in a broader field involves.

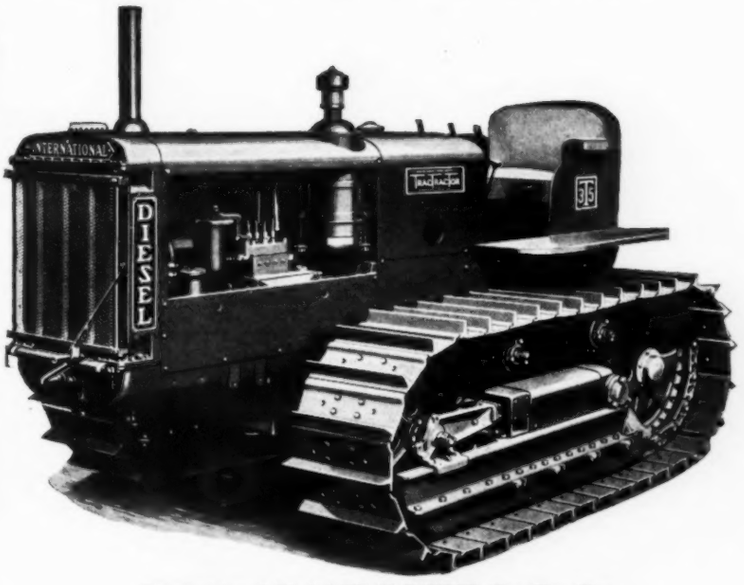
Effect of Design Policy and Physical Conditions

Beside the problems the nature of the material to be handled presents, design policy has, in the past, con-

INTERNATIONAL *Announces* Two New TRACTRACTORS

● The popular features which have won International TracTracTors such an enviable position in the crawler tractor field are now available in two new TracTracTors. One is the Model TD-35 DIESEL, which follows the design of the larger Model TD-40 and brings you the many advantages of the International DIESEL Engine in a somewhat smaller tractor at a lower price. The TD-35 is a true DIESEL—in design, performance, and economy—yet it starts on gasoline and converts itself automatically to full DIESEL operation after warming up for one minute or less.

The other new TracTracTor is the Model T-35—a 6-cylinder spark-ignition-type tractor built for efficient operation on gasoline or distillate.



International Model TD-35 DIESEL TracTracTor

With the exception of the engines, these two new TracTracTors are practically identical. Both feature variable-speed governors; 5-speed transmissions; ball bearings at 43 points; replaceable cylinders; Tocco electrically hardened crankshafts; special dust seals; fuel strainers; air cleaners; oil filters; and unit construction throughout. With this type of construction, important working parts may be removed as units, enabling the owner to make adjustments or replacements in the shortest possible time. This important time-saving feature keeps maintenance costs down.

These two new International TracTracTors (available in standard or wide tread) are already serving many branches of industry, adding to the reputation built up through the years by the International T-20, T-40, and TD-40 DIESEL. International Industrial Power also includes a full line of wheel tractors, and power units in sizes up to 110 maximum horsepower.

The nearest International Industrial Power dealer or Company-owned branch will gladly supply complete details on request.

International Model T-35 TracTracTor

INTERNATIONAL HARVESTER COMPANY
(INCORPORATED)
Harvester Building Chicago, Illinois

Brief Specifications

	Model T-35	Model TD-35
*Belt horsepower (max.)	46	43
*Drawbar horsepower (max.)	38.5	36
Speeds in m.p.h. at 1750 r.p.m.	1¾ to 4	1¾ to 4
Number of cylinders	6	4
Bore and stroke, inches	3⅝ x 4½	4½ x 6½
R.p.m., full-load engine speed	1750	1100
Length overall, inches	132⅛	132⅛
Width overall, inches	58¼	58¼
Height, base of shoe to top of air cleaner, inches	76¼	76¼
Shipping Weights (approximate)		
Standard tread	10,050	10,550
Wide tread	10,800	11,300

*Official Tests

INTERNATIONAL Industrial Power

Loup Highway Grading in Washington (Station 360), Showing One of Two 12-yd. Scrapers And 95 HP Tractor Excavating Sand Cut.

siderably influenced the selection of equipment and does so to some extent at the present time. From the contractors' standpoint the important aspects of design policy are the lengths of haul and the widths of cuts and fills that result from the application of this policy. Not many years ago Fresnos and wheel scrapers were able to compete pretty successfully with power shovels. They have practically disappeared from the highway grading field because modern highway design imposes lengths of haul that are beyond the haul limits within which the use of equipment of this sort is economical.

It has taken some time to introduce the larger hauling units now very commonly found on highway grading jobs. To a certain extent this has been the result of the fact that, as at first introduced, these units were not fully perfected but to a greater degree it has been the result of the fact that embankment widths did not provide the freedom of maneuver that was desirable. As design policy has been changed to provide for wider and wider embankments the correspondingly greater freedom of movement thus provided has encouraged the use of large units.

The regional differences in the customary tooling of a grading outfit which result from the influence of these factors are rather conspicuous. Thus, in the East, where there is a good deal of rock work, the customary grading outfit is a power shovel outfit. In the prairie regions of the middle west—more particularly west of the Mississippi —the customary outfit has been an elevating grader outfit. In the far west the heavy tractor-drawn scrapers compete actively with other types of equipment though it should be observed that these units are rapidly coming into use in the Middle West, and in the South and are beginning to appear in the East.

The fact that these regional customs as to the tooling of a grading outfit exist, and that they are at least largely the result of physical conditions and design policy, places the contractor in this position: If he purchases an outfit of the sort that is customarily used in the region in which he works, he thereafter competes, so far as his outfit is concerned, on equal terms with others who are working in that region. If he purchases an outfit of some different type the basis on which he can compete is altered. In the past it has been pretty generally true that while prices on grading work vary a good deal from year to year—rising as economic conditions improve and falling when economic conditions become unsettled—at any particular time there is a pretty well recognized market price for grading work, which market price is applicable on work offered in the region—usually the State—involved. The reasons for this need no discussion here.

In practice this prevailing market price results from competition among those who are equipped to handle grading work in the customary way. It naturally follows that the contractor who has an outfit which, by reason of the manner in which it is equipped, can produce at a cost that is below the cost at which a customarily equipped outfit can produce, has a definite advantage. While, in the very nature of the case, this advantage only obtains on projects which provide work his outfit is suited to handle, as long as such projects are presented with enough frequency to enable him to keep his outfit busy, his preferential position remains.

It is, of course, quite equally true that if his regionally non-standard outfit cannot produce as cheaply as the regionally customary outfit, he is at a disadvantage though, in practice, this disadvantage may be more apparent than real. In a good many of the prairie states west of the Mississippi, prevailing prices on common excavation have, until recently, been pretty definitely based on handling the work with elevating grader outfits. Such outfits are peculiarly well fitted for work in this region, with the result that until the recent introduction of the tractor-drawn scraper, there was relatively little competition offered by outfits of other types. However, in spite of this situation, some contractors owned power shovel outfits with which they were able to do very well indeed by rather definitely limiting their endeavors to secure work on those projects which, for one reason or another, so evidently could not be handled to advantage by the customary elevating grader outfits that advantageous prices could be obtained on the work they involved.

Kind of Outfit Dictates Competitive Position

These and other aspects of this matter which need no comment here, all tend to emphasize the fact that for the man who is moving dirt as a business, or as an important part of a business of wider scope, the kind of an outfit selected pretty definitely dictates his competitive position. A customary outfit—that is an outfit of the general type usually found in that region—means an average competi-

20-TON LOADS CUT DIRT-MOVING TIME ON ALL-AMERICAN CANAL

New Type Goodrich Tires Speed Work—Cut Costs

Out west they do things in a big way. Right now they're building the All-American Canal—an 80-mile waterway from the Colorado River through California's Imperial Valley. It's one of the largest dirt-moving projects on record. Three and one-half million yards of earth will be moved before the canal is completed.

Big, massive trucks of the George W. Condon Co. haul away 20 tons of dirt at a load. But only with a new kind of tire were these trucks practical. Goodrich engineers designed a special tire (it weighs almost 500 pounds) just for such service.

At the Canal and at some of the big government dams, these tires not only withstand the strain of crushing loads but carry on where the ground temperature reaches as high as 140°. They plow through loose sand, over jagged rock—all in all, the toughest jobs man ever handed tires.

These earth-mover tires are Goodrich Super-Tractions, specially-built huskies that can carry nine tons each. The tread design provides positive traction and resistance to spinning and sideslip. A riding bar in the center of the tires distributes the load and provides long, even wear.

Tires Triple Protected

Like all Goodrich Silvertowns, this tire is Triple Protected against sidewall breaks and blow-outs. This exclusive Goodrich construction actually checks 80% of all premature tire failures.

You don't have to have 20-ton loads in order to get the savings of Goodrich Super-Traction Silvertowns. These tires are available in sizes from 6:00-20 to 18:00-24—a size and type for every construction job.

Whether you need tires for trucks or air compressors, concrete mixers or tar kettles, scrapers or concrete buggies, the Goodrich dealer has a *special tire* at a money-saving price. Call him today for prices.

Goodrich Earth-Mover Tires at work on a government dam.

Goodrich *Triple Protected* **Silvertowns**

SPECIFY THESE NEW SILVERTOWN TIRES FOR TRUCKS AND BUSES

tive position. Any other type of an outfit is likely to mean some restriction in the field in which work can be taken and with this restriction some difference in competitive position—a favorable difference if the selection of an outfit is a logical one, an unfavorable difference if it is not.

The position of the contractor who is working where grading and paving are let in one contract is a little different from the position of the man who is interested only in grading. Such a contractor is likely to feel that as paving usually is the larger part of a job which involves both grading and paving, his grading outfit must be such that it can be used to handle whatever type of grading he must take in order to obtain the paving work he wishes to secure. The very common result is the selection of a shovel outfit. Such an outfit will consist of a power shovel that can be converted into a dragline or a crane, a string of trucks and a roller with necessary correlated equipment. When the grading is finished and the surfacing is to be laid, the shovel goes to the gravel pit and the trucks haul the gravel. The roller is as useful on the surfacing as it was on the subgrade. Similarly, in laying concrete pavement, with the conversion of the shovel into a crane, the major part of the grading outfit is as useful on the paving work as it was on the grading, for with the shovel, now a crane, in the materials yard, the trucks on batch hauling and the roller compacting the fine grading, the larger part of the equipment required on the grading work is kept busy and the total investment in equipment is held at a minimum, which always is an important consideration in this day of highly mechanized operation.

The Factor of Equipment Costs

The above comments refer only to the effect of physical conditions and design policies as affecting the choice of equipment. The nub of the situation is that while a power shovel can handle practically any sort of digging, its principal competitors in the digging field, the elevating grader and the tractor-drawn scrapers are effective tools only in a more restricted field. But the selection of the type of equipment to be used cannot be governed entirely by these considerations. As factors in the selection of the type of equipment to be purchased, they require careful study but no final decision on what to purchase under given conditions can properly be made without some consideration of the cost at which the available types of equipment will produce. There are such differences and they are both fundamental and inescapable. Thus, as between a power shovel outfit and an elevating grader outfit, the only fundamental difference is in the digging and loading unit employed. The tooling of the hauling operation and of the dump can be and frequently is the same for both types of digging and loading equipment except that, in general, a little less hauling equipment is needed with an elevating grader than ordinarily is used with a shovel that is turning out the same yardage because, in ordinary practice, the elevating grader loads the hauling units somewhat more heavily. This being the case, the difference in the cost at which an elevating grader outfit and a power shovel outfit of equal ordinary output capacity will produce lies (a) in the diflerence in the ownership expense that the two types of digging equipment involve, (b) in the difference in the operating expense these units involve and (c), finally, in the difference in hauling costs.

As to the first of these, a 2½ yard shovel will cost some $20,000 to $25,000. An elevating grader, with the tractor to haul it, with ordinary efficiency of operation assumed in both cases, which has about the same output capacity, will cost about $10,000. It is evident that the difference in the cost of these two styles of digging equipment will produce an appreciable difference in ownership expense.

The difference in operating cost is not as great. The shovel requires an operator and an oiler or a pitman who will help with the oiling. The elevating grader outfit requires a tractor operator and a plow holder. The wages paid these men vary rather widely but, in any particular region the combined wages of the shovel runner and the pitman are about the same as the combined wages of the tractor operator and the plow holder.

Fuel and oil for the shovel is somewhat more expensive than fuel and oil for the elevating grader and the tractor which pulls it. Repair costs on the shovel will average higher than on the elevating grader and tractor which is as would be expected in view of the fact that the shovel is considerably the more expensive unit. Here, again, the normal expense of operating outfits of the same capacity favors the elevating grader outfit.

The advantage the elevating grader outfit has in hauling costs is rather more a matter of custom than it is of necessity. In the days of horse-drawn wagons and ¾-yard

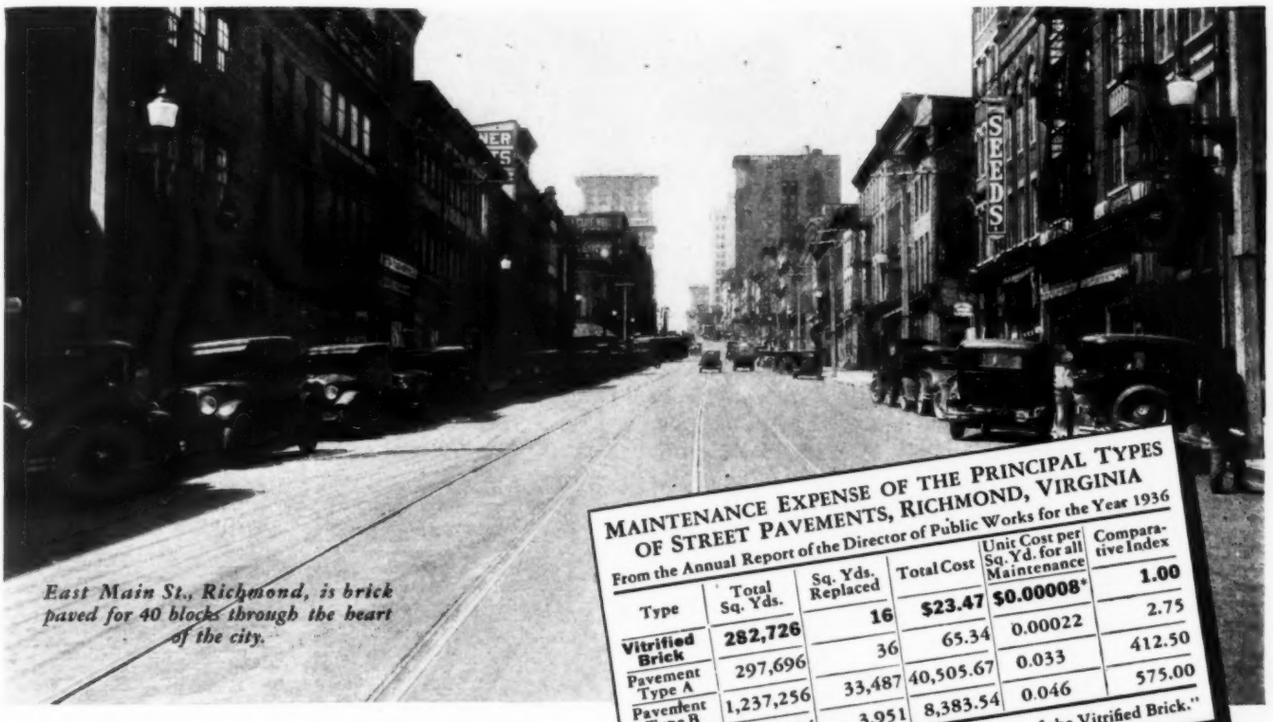
Elevating Grader in Action.

$1^{00} = \$2^{75} = \$412^{50} = \$575^{00}$

(or)

Pavement Maintenance Costs

at RICHMOND, VA.



East Main St., Richmond, is brick paved for 40 blocks through the heart of the city.

MAINTENANCE EXPENSE OF THE PRINCIPAL TYPES OF STREET PAVEMENTS, RICHMOND, VIRGINIA

From the Annual Report of the Director of Public Works for the Year 1936

Type	Total Sq. Yds.	Sq. Yds. Replaced	Total Cost	Unit Cost per Sq. Yd. for all Maintenance	Comparative Index
Vitrified Brick	**282,726**	**16**	**$23.47**	**$0.00008***	**1.00**
Pavement Type A	297,696	36	65.34	0.00022	2.75
Pavement Type B	1,237,256	33,487	40,505.67	0.033	412.50
Pavement Type C	180,984	3,951	8,383.54	0.046	575.00

*"Maintenance due to causes other than the failure of the Vitrified Brick."

● Of course, you've always known that of all the pavement types, brick is far less expensive to maintain.

But how those official figures for Richmond, Va., give point and definite form to an old truth!

Brick maintenance for 1/575th of the maintenance cost of another well-known type is quite a lot of difference!

So. 2nd Street was brick paved last year.

Brick pavements are now in daily use after nearly 50 years of exposure to weather and traffic. With such a long life and such a low maintenance, brick is indeed the greatest of all paving values!

The reason for long life and low cost of brick pavement is due to the fact that it withstands weather as well as traffic. Changes in temperature and atmospheric moisture damage most pavements. Brick is more highly resistant to these natural causes of damage than any other type. In addition it is highly resistant to traffic damage.

Use vitrified brick on new jobs. Various types of old pavement may be easily resurfaced with brick. National Paving Brick Association (Affiliated with Structural Clay Products Institute), National Press Building, Washington, D. C.

BRICK

FOR NEW AND RESURFACE JOBS

Power Shovel on Blue Ridge Parkway in North Carolina Loading Earth into Trucks.

shovels, it was the usual practice to give each wagon 2 dipper loads—in good common about 0.9 cubic yard per load. Elevating graders usually loaded at least 1.2 cubic yards per load, which, in practice, meant that to handle a given yardage over any given distance, the shovel used about one-third more hauling units than the elevating grader. As the size of the hauling units has increased this difference has tended to decrease but even today the loadings under an elevating grader are obviously heavier than they usually are under a shovel. The reason for this, of course, lies in the fact that the elevating grader can distribute the load better than the shovel which, by reason of the fact that there is no control over what the dipper is delivering once the bottom of the dipper is released, must drop the whole of its load in one spot. This does not mean that full loadings are impossible. It merely means that they take more time, and, in particular, that to trim out all loads to the full capacity of the hauling units, involves the use of a good many fractional dipper loads. The resulting ordinary practice is to put 2, 3, 4 or some larger number of dipperfuls on the hauling unit, this number being held constant whether or not a full load results. Inevitably a good many light loads are sent to the dump—a most unusual circumstance where elevating graders are used. A somewhat increased hauling expense, as compared with similar costs on elevating grader jobs, results.

In summary these three items of expense generate a cost differential that is definitely in favor of the elevating grader outfit. The fact that these outfits have, until recently, been used to the practical exclusion of any other type of outfit for handling good common excavation in the prairie regions is the direct result.

As between the elevating grader outfit and the modern tractor-drawn large scrapers, the differential is even wider, but here it is an adverse differential. The modern elevating grader outfit consists of a tractor-drawn elevating grader and, it may be assumed, several tractor-drawn dump wagons. In fact trucks are often used with the elevating grader but this fact does not alter the point of the observations which follow. The management of the dump may be presumed to be and, in fact, usually, is about the same for both outfits. The modern scraper outfit merely replaces the tractor-drawn grader and the tractor-drawn dump wagons with tractor-drawn scrapers, the cost, combined unit for combined unit, being about the same for both types of outfit. In other words, on the scraper outfit the elevating grader and the four large wagons used to haul its diggings, become five tractor-drawn scrapers. There is no saving in ownership expense, only a little—the cost of the plow holder—in labor, and none worthy of note in operating expense. But there is one very important saving—the scraper outfit seldom needs to work on any other basis than at from 80 per cent to 100 per cent of full utilization of the equipment of which it is composed! The advantage it has at this point is great. In the highway field it is inevitable that the haul distance will not only change frequently but that it will change within rather wide limits. No contractor normally expects to provide enough hauling units to keep his digging tool fully occupied when the haul is long. On the other hand he does not, in practice, keep his hauling units fully occupied when the haul is short. As a result it is his normal and usual experience that during much of the time either his digging unit or his hauling units are forced to work at less than full output capacity. But the scraper outfit labors under no such disadvantage. Each unit being complete in itself it can be made to work at full capacity day in and day out whether the haul is long or whether it is short. The advantage the scraper outfit has can, then, be stated in general terms as about the difference there is between an approximately full utilization of productive capacity and the definitely less than full utilization that, on ordinary highway work, can be made of the capacity of the outfit, taken as a whole, when a power shovel or an elevating grader is in use.

The above statement of the fundamental factors which affect the cost at which dirt can be moved by these styles of outfits is sufficient for the purpose here in mind—that is to show that there are such differences and to indicate their general relation to other factors, which are to be considered in the selection of grading equipment. They will be discussed in somewhat greater detail in articles which deal with the management of each of these types of outfit.

Effect of Management

Finally as to the general factors to be considered in this connection, notation must be made of the fact that there

GALION GRADERS

are WHEELED to MASTER the TOUGHEST JOBS

Tension-Bilt STEEL WHEELS

● French & Hecht Tension-Bilt wheels remain permanently Round and True.

● Service like this calls for real wheel stamina. Tension-Bilt wheels have it.

It's a hard life, that of a road grader. Plenty of easy jobs come along it's true, but every so often action is called for on a bit of grading that brings into play every ounce of rugged strength modern engineering can build into road equipment.

That's when WHEEL STRENGTH becomes of paramount importance. The Galion engineers know that every impact, as the blades strike stones, buried stumps or hard impacted clay, find their way into the Shock Zone where they exert the full force of their viciousness upon the wheels.

No matter how tough the job, the Galion Grader must go through without the slightest chance of expensive breakdown delays—and they DO, for Galion Graders are mounted on French & Hecht Tension-Bilt Steel Grader Wheels. These lighter but STRONGER wheels fight off shocks and strains at the instant of impact and dissipate them into harmlessness. This capacity for "taking punishment" and calling for more, has made French & Hecht Tension-Bilt Steel Wheels outstanding in modern industry and agriculture—unchallenged leaders in long-lived dependability.

We invite manufacturers of wheeled equipment to call upon our wealth of experience in determining the BEST wheel for ANY duty.

FRENCH & HECHT, INC.

DAVENPORT, IOWA SPRINGFIELD, OHIO

EXCLUSIVE WHEEL BUILDERS TO INDUSTRY SINCE 1888

is a good deal of difference in the ease with which outfits of different styles can be managed, to say nothing of the difference in the effect of adverse weather conditions on the behavior of outfits of these various types. In principle and in practice the management problems which are faced in handling a power shovel outfit and an elevating grader outfit are very similar. Operation with either type of outfit is a constant struggle to keep the average utilization of the outfit as a whole at the highest possible point. With the haul distance varying from day to day—sometimes oftener—sometimes not as often—and varying from less than a hundred feet to two or three thousand, the problem of determining how many hauling units to send out to the job is no simple matter. Once that number is determined, the problem of effectively utilizing them is ever present. If the haul is long the digging unit is certain to be idle a good deal of the time. If it is normal the problem of keeping the hauling units moving steadily keeps cropping up. When the haul is short the full utilization of the hauling equipment is impossible. The inevitable result is that the average utilization of the equipment is well under 100 per cent—often very much under it. This, in effect, means that the capital invested in equipment must always be correspondingly greater than would be required if all of it could be kept busy all of the time. This, in itself, is of considerable importance from the cost standpoint and should offer sufficient incentive for giving a great deal of thought to the manner in which each job is to be tooled. But the management problem is far broader than this for even with an outfit of the proper size, job conditions being considered, keeping it effectively at work remains a constant problem which adverse weather and soft subgrades, labor problems and a thousand and one other things serve constantly to complicate.

In contrast with the complexities that the management of power shovel and elevating grader outfits involve, the management of a tractor-drawn scraper outfit is simplicity itself. Each unit takes on its own load, hauls it, dumps it in layers of any desired thickness and, owing to its weight when loaded, does all of the rolling that is required in some regions and even when rollers are required, does a good part of the rolling. The cost of operation, output considered, is low. Moreover, all of the problem of correctly tooling successive operations is avoided, because the one unit handles all of them itself! When the haul is short it spends a good fraction of the time digging. When the haul is long it spends more of the time hauling but always —regardless of the length of the haul—and the frequency with which it changes—it remains fully occupied. In short the whole investment can be and as a rule is kept pretty fully employed all of the time. Another consideration that is important from the management standpoint is that each unit is complete in itself; it matters little whether one unit or a dozen of them are at work on a job so far as managing them is concerned, for the operations of no one of them is in any way dependent on the operations of any other. Regardless of number they remain wholly isolated producers, the output of each being dependent only on its own activity and the physical conditions at the moment prevailing. This makes the full utilization of the investment and its expression in production so simple a matter that it gives this type of a grading outfit an advantage that, under practical working conditions, is highly important.

Michigan State Highway Department Reorganized

A reorganization of the personnel of the Michigan State Highway Department has been put into effect. The reorganization follows the recommendations of the Business Research Corporation, of Chicago, which has been making a job classification and personnel study of the department the last several weeks.

The study gives the department a definite classification for each job in the organization together with minimum and maximum salary limits for these posts and qualifications and duties for every department employe.

Outstanding changes include the appointment of three deputies with assistants, an additional assistant to the maintenance engineer, creation of a metropolitan branch office at Detroit, and an Upper Peninsula branch at Escanaba, and a general shake-up in field personnel. Salary increases of $26,900 were made.

G. D. Kennedy, who has been business manager-consulting engineer, becomes deputy commissioner in charge of business administration; V. B. Steinbaugh, former deputy-road engineer, is deputy commissioner-chief engineer; and Deputy Harry C. Coons becomes deputy commissioner in charge of construction and operation.

Other important changes are: Consolidation of Wayne County into a separate district with Harold F. Zumstein, former district engineer in District 8, placed in charge of both construction and maintenance; promotion of Edward W. Schwoppe, former district engineer and B. R. Downey, former assistant district engineer in charge of maintenance, both in the Cadillac district, to assistant maintenance engineers; promotion of William H. Harvie, former district engineer in the Grand Rapids district, to road engineer with offices in Lansing; transfer of T. L. K. Donnelly, former assistant district engineer in the Saginaw district to the construction division and the same with N. W. Paquette, who held the same post at Crystal Falls; promotion of former district engineers—R. A. Beers, of the Kalamazoo district, and H. F. Rye, of the Newberry district—to assistant road engineers with offices in Lansing; appointment of M. J. Walker, former assistant district engineer for the WPA in the Upper Peninsula, to assistant road engineer at Lansing; designation of the Escanaba offices as the Upper Peninsula branch with Ben F. Sparks continuing as Upper Peninsula engineer.

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Traffic Engineering Training School

A two weeks intensive training course will be held Aug. 16 to 28 by the Bureau for Street Traffic Research, Howard University and the Institute of Traffic Engineers. The course will be held at the University, Aug. 16 to Aug. 28. It is intended for men who are now employed by cities, counties and states and who may be assigned to traffic engineering duties and responsibilities.

The course will concentrate on the practical approaches to the technical problems of traffic control and regulation in order to provide this engineering group with techniques of proved value which they can utilize in their own communities. The various subjects will be handled by experienced traffic engineers and specialists who are recognized as leaders in the profession.

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PLASTIC FLOW AND VOLUME CHANGES OF CONCRETE

ONE of the outstanding papers at the annual meeting of the American Society for Testing Materials (June 28-July 2) was presented by R. E. Davis, H. E. Davis, and E. H. Brown, of the University of California. It gave the results of important research work carried on over many years having to do with volume changes of concrete and pointed out the significance as applied to design and construction problems. The paper is devoted chiefly to volume changes under the action of sustained loads, which is termed plastic flow. The authors point out that as a result of the research of recent years, there has been developed a general conception of the effect of shrinkage and plastic flow upon the behavior of concrete structures, which is already leading to marked changes in design and construction practices. These changes perhaps mark a new era of development in the art and science of concrete construction. A synopsis of the paper follows.

It is now generally believed that shrinkage and plastic flow are closely related phenomena, each being primarily due to changes in the amount of adsorbed water in the cement gel and being but little directly influenced by the free water occupying the pore spaces within the concrete mass.

On the whole, plastic flow does not seem to be an undesirable property. In certain reinforced concrete members it tends to make possible more efficient use of steel, and in thin structures subjected to drying, as well as in mass structures subjected to thermal changes due to the hydration of cement, it tends to promote a more favorable distribution of stresses than would otherwise exist.

Investigations at University of California

Started in 1926, plastic flow investigations at the Engineering Materials Laboratory, University of California, have comprised to date some 25 series of tests. Recent series of tests, undertaken during the period 1934 to 137, have included studies to determine (1) effect of water-cement ratio and aggregate-cement ratio upon plastic flow, (2) effect of fineness and composition of cement upon plastic flow, (3) plastic flow of concretes in tension and in compression, (4) fiber strains in plain concrete beams under constant sustained bending moment, and (5) stresses developed in large concrete cylinders under complete axial restraint during a heating-cooling cycle similar to that which will occur in mass concrete.

Observations of plain concrete cylinders which have been under various intensities of sustained compressive stress for a period of 10 years indicate that the plastic flow is still increasing at a measurable rate. In the extreme case of a sustained stress of 900 lb. per square inch, the total flow of air-stored specimens for the 10-year period has amounted to more than 1.3 in. per 100 ft. The total flow of water-stored specimens is of the order of ⅓ to ½ of those of air-stored specimens, but at the later ages it is observed that the rate of flow is greater for the water-stored specimens than for the air-stored specimens.

In a series of tests on reinforced concrete columns which have now been under load for a period of 5½ years, the stress in the steel is still increasing and the stress in the concrete is still decreasing at the end of this period. For dry-air storage for columns carrying a large percentage of reinforcement, due to the combined effect of shrinkage and flow, the concrete is actually in tension, and all of the load is carried by the steel. For dry-air storage and for columns carrying a small percentage of reinforcement, the stress in the steel during the loading period has increased from 8000 to 42,000 lb. per square inch, while the stress in the concrete has decreased from 1000 to 300 lb. per square inch.

At the end of 5½ years, the stress in the steel for columns stored in dry air is three or four times that of corresponding columns stored under water.

In order directly to determine the effect of aggregate-cement ratio and water-cement ratio upon plastic flow, a series of tests was undertaken in which for concretes of each of three different cement contents, two different water-cement ratios were employed. The tests were carried out in air at 50 percent relative humidity and 70° F.

The effect of water-cement ratio upon plastic flow is marked. The results up to the age of about two years show that between two concretes of equal cement content, the one having the higher water-cement ratio exhibits the largest flow. For example, the flow for a water-cement ratio of 0.7 was 50 percent greater than for a water-cement ratio of 0.6. For concretes having the same water-cement ratio, the richer mixes exhibit more flow than the leaner mixes, and the magnitude of the flow is directly proportional to the cement content.

There appears the interesting possibility that the particle-size distribution of a cement, through its effect upon the structure of the hardened cement paste, may have an important influence upon the rate and magnitude of volume changes in general.

Tension vs. Compression

It has frequently been assumed that flow of concrete in tension is approximately the same as the flow in compression. The results of two series of tests indicate that this is not true, but definitely show that for certain cements, including low-heat and normal portlands, the flow in tension is considerably greater than that in compression, at least up to the age of six months.

It has been observed, however, that after a few weeks under load the rate of tensile flow may be less than the rate of compressive flow. This points to the possibility that flow in compression may in time equal or exceed that in tension.

The results of the two groups of tests just described demonstrate the very marked effect of the humidity of the surrounding air upon both the plastic flow and upon

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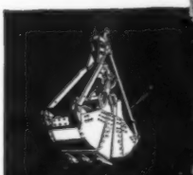

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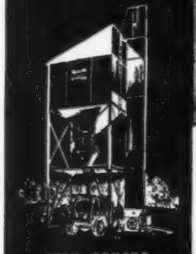

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the modulus of rupture of concrete subjected to sustained bending moment. Obviously whether the structural element be plain or reinforced, it is desirable that the concrete of which it is composed be of a quality which under drying conditions will exhibit maximum flexural strength under sustained moment. In other words, it is desirable that the concrete be one in which the effects of plastic flow and shrinkage due to drying, one tending to offset the other, would combine to produce the most favorable distribution of stresses.

Effect of Fineness and Composition of Cement upon Plastic Flow

The results of observations of plastic flow of mass cured concretes made with a normal portland and a low-heat portland, each ground to the same surface area, show a marked effect of composition of cement upon plastic flow in compression. Up to four months, the flow of the low-heat portland is approximately double that of the normal portland.

In a further series of tests undertaken to study the effect of fineness of cement upon flow it has been observed that concrete containing coarsely ground low-heat portland cement exhibited much the largest plastic flow at all ages.

Certain European experience has pointed to the desirability of employing relatively coarse low-heat cements for mass structures, in order to reduce cracking to a minimum. The Crystal Springs Dam, south of San Francisco, built nearly 50 years ago with a coarse cement of composition quite similar to that of our modern low-heat cements, is perhaps one of the finest examples of our older structures, located in a comparatively dry climate, that has developed almost no cracks nor surface checks. The same general freedom from cracks is also observed in the recently constructed Morris Dam, where the modern type of low-heat cement was employed for the first time in this country. On the other hand, where modern, more rapid-hardening portland cements of normal or modified composition and comparatively high fineness have been employed, mass structures have shown frequent cracks of considerable magnitude. It is believed that this difference in degree of cracking in service structures under field conditions can be accounted for in no other way than through differences in the plastic flow characteristics of the concretes of which these structures are composed, primarily due to differences in composition of cement.

Stresses Due to Thermal Changes

In an attempt to determine the stresses which may be developed in concrete under temperature conditions similar to those occurring in mass concrete, tests were made on 12 by 48-in. concrete cylinders which were maintained at constant length during a temperature cycle of approximately that which has been observed as the mass heats and cools, with a temperature varying from 60° to 94° F. Under these conditions of complete restraint, the compressive stress reached a maximum of 125 lb. per square inch at the age of three days. When the temperature had reached a maximum at the age of 25 days, the compressive stress had decreased to 110 lb. per square inch. At the age of 40 days, when the temperature had declined only 5° F. from the maximum, the compressive stress in the restrained specimen had declined to zero. At the age of 80 days, when the temperature was still 20° F. above the initial temperature, the tensile stress in the concrete had increased to 200 lb. per square inch.

While no concrete structure is completely restrained and therefore the thermal stresses developed during the course of the experiment just described were in excess of those which would actually be set up in a structure built of the given concrete and subjected to the given temperature changes, yet in the cases of thick walls, heavy foundation, bridge piers, and dams resting on rock foundations, the conditions of the experiment may be approached. For this reason the results are of value as indicating in many mass structures the existence of high stresses due to heating and cooling, not only in the vicinity of the foundation rock but at exposed faces, keyways, and along construction-joint planes between lifts. In certain types of structures these residual stresses due to thermal changes may not be a matter of importance. In the case of dams, however, these stresses, in combination with those due to load, may produce a stress system far different from that calculated by the usual methods of analysis which entirely ignores the effects of thermal changes. The condition of dams, where there are in evidence many structural cracks in spite of contraction joints, makes it appear that this must be true.

The results are also of value in showing the large part that plastic flow plays in the development of stress during the heating-cooling cycle, and in indicating a method which may be employed in experimentally determining the magnitudes of thermal stresses that are likely to occur in any proposed structure. When through the results of extensive experiment there have been established the time-flow-stress-temperature-restraint relationships for a wide variety of conditions, they may be employed in a rational method of thermal stress analysis.

▼

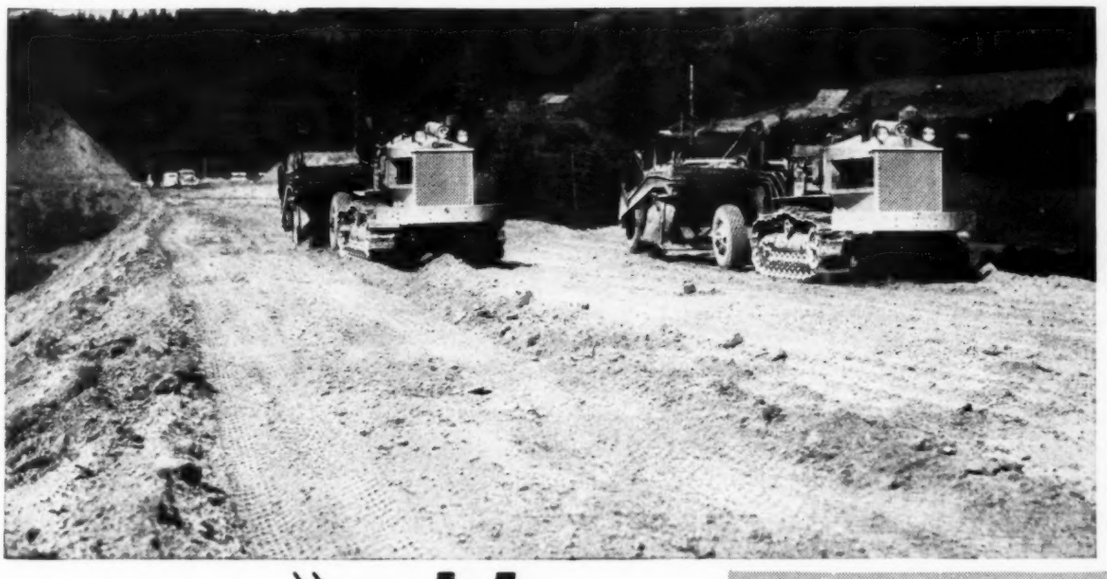
Determining Most Effective Method of Traffic Speed Zoning

Experiments are now being conducted by the Minnesota State Highway Department to determine the most effectife methods of traffic speed zoning under the new Minnesota Uniform Traffic Code. The studies are being made on a 150 mile section of Trunk Highway 169 from Elk River, to Grand Rapids, Minn. This highway was selected because of the wide variety of traffic volume, it being thought best for experimental purposes to avoid roads which carried extremes of either heavy or light traffic, and those too uniform in type.

On this road will be worked out the factors of traffic control which will determine the various speed zones to be posted under varying conditions of traffic and roadbed throughout the nearly 11,500 miles of the state trunk highway system. Among other things to be determined will be the arrangement and design of signs to be used in posting the roads for the various speed zones provided by law.

Experimental signs, in various sizes, colors, and types of lettering have been placed and it is the intention to obtain the reaction of as many drivers as possible to the various speeds posted on various sections of road, which types of sign are more legible and more commanding, and the efficacy of other methods tried out.

DAY and NIGHT



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Methods and Cost of Jacking 200 Ft. Pipe Culvert

THE first pipe jacking operation undertaken by the Pennsylvania Highway Department was completed recently under a highway near Pittsburgh. A 36-in. corrugated iron pipe was jacked through a 200-ft. fill.

The setup consisted essentially of a jacking abutment, a guide for the pipe, two 50-ton jacks, and the necessary blocking and fittings to transmit the pressure of the jacks to the pipe.

After the material had been assembled and the location of the proposed pipe determined, it was decided to jack the pipe from the lower end. It was found by measurement that the pipe would have a grade of 2.9 per cent to reach the chosen point at the upstream end.

The most important phase was the jacking abutment. Because of the marshy nature of the soil, the bulkhead did not have sufficient resistance to the thrust of the jacks and it was necessary to hold it down with cables attached to dead men, and with sandbags piled on a platform.

A track was laid for the guidance of the pipe. This consisted of two 12-in. x 12-in. timbers, laid 18 in. between their near faces. These were set at the proposed grade and armored on the inside upper edges with 3-in. x 3-in. x 5/16-in. angles.

The department purchased two 50-ton jacks with 24-in. lift for the project. The jacks, weighing 310 lb. each, were well suited to this type of pipe jacking as the unusual lift avoided frequent changing of the blocking. They also will be useful for bridge jobs and similar work in the future.

A shed was built over the jacking layout to protect the men from weather conditions since it was considered necessary to keep the pipe moving day and night. This brought up the question of lighting and a small gasoline driven lighting plant was used. An extension line was carried into the pipe to light the work of the diggers. This was better than oil lamps, both for efficiency and ventilation.

Ventilation early became a matter of concern and a bad odor apparently due to decaying vegetation became noticeable after a short time. A department air compressor was installed, together with a rented hand digging machine with spade blades, and the air from this equipment did the double service of power and ventilation.

Jacking Anchorage

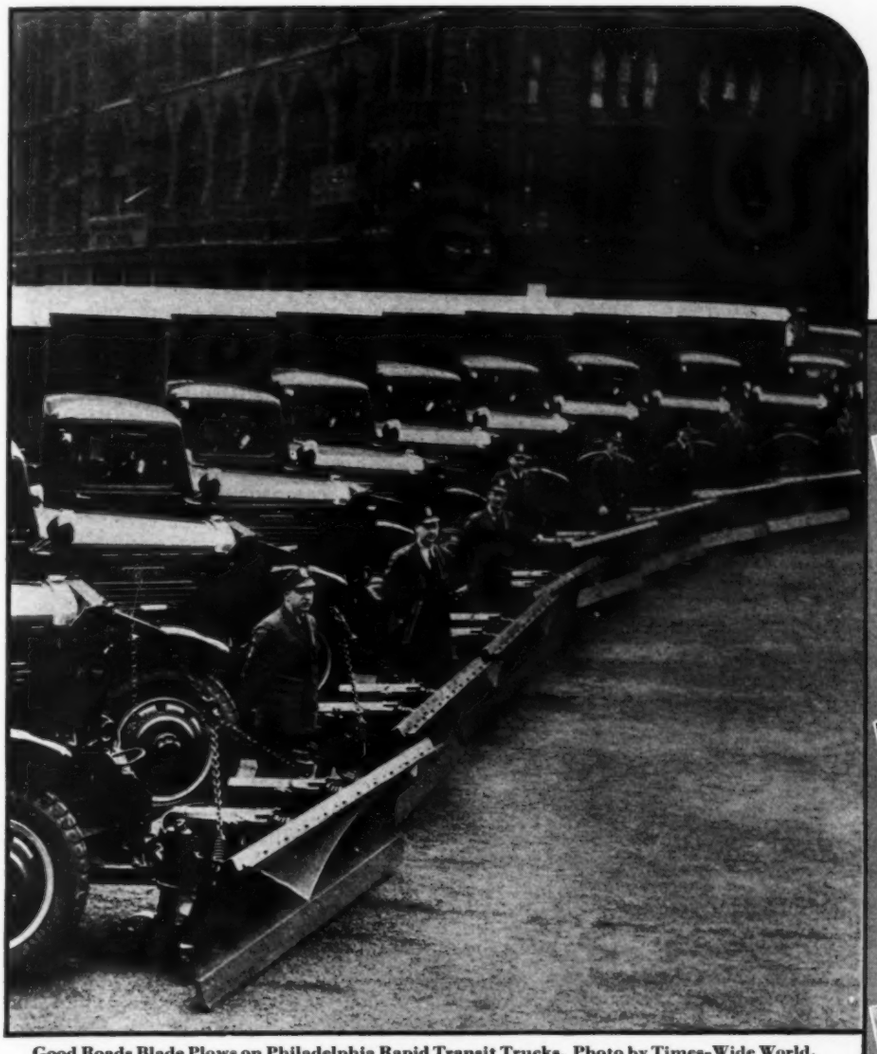
The pipe was ⅛ in. thick corrugated iron in 10-ft. sections except the first two which were 12 ft. long. On top and bottom were riveted slip plates with the corrugations running longitudinally. These were designed to lower friction on the pipe caused by the transverse corrugations.

Four coal miners were used in digging the first 100 ft., two men on each 12-hour shift. Each man worked in the pipe a half hour, then rested the same length of time. Afterwards, two more diggers were put on, one on each shift.

The method of directing the pipe was as follows: Two boards ½ in. x 3 in. x 36 in. were bolted together in the center so they could be folded up or opened to right angles at the digger's convenience. Each board had slits cut in it about 6 in. long. When set up and levelled with a carpenter's hand level, one arm was horizontal and one vertical. The digger, by holding his lamp behind each slit in succession, made it visible from outside where line and grade sights were placed clear of the work.

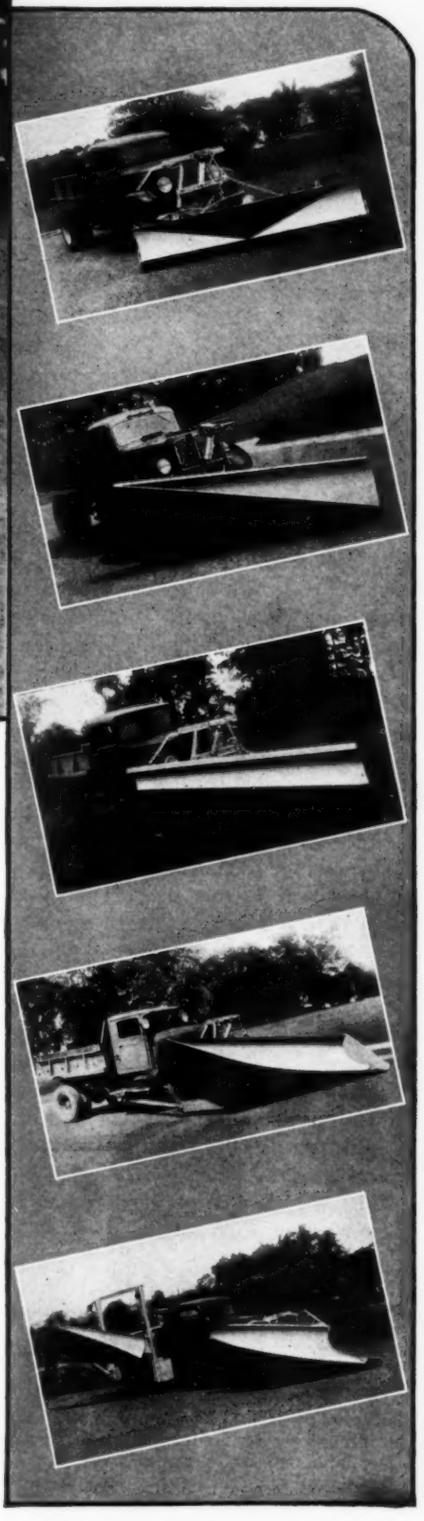
It was important to hold to line and grade as closely as possible and this was done by digging more out on the side to which the pipe needed directing, leaving the other

The Fill and Jacking Shed



Good Roads Blade Plows on Philadelphia Rapid Transit Trucks. Photo by Times-Wide World.

Good Roads MACHINERY



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New Pipe Breaking Through—At Left
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side tight and helping with the bar. This, however, left a tight spot which increased the friction. The line and grade had to be watched frequently to prevent these spots from being too large. Shallow trenches were excavated across the bottom of the tunnel at frequent intervals to prevent any loose material which might be carried along with the pipe from accumulating to an extent which would interfere with jacking. Few large stones were encountered. The fill was largely a homogenous mixture of clay and small stones or shale.

When not using the air digger, the men used spades with cut-down handles about 18 in. long. They also used short-handled miner's picks and dug 2 ft. ahead of the pipe with about 3 in. clearance all around. The pipe was then jacked and digging resumed.

Labor at the jacks was divided into three shifts of eight hours each, six men to each shift. From the time jacking was started until it was completed, 18 days and 14 hours of practically continuous work elapsed. About two days in all were lost resetting the jacking abutment. The average progress was better than a 10-ft. section a day.

The chief difficulty was holding the jacking abutment in place and it was necessary to anchor it down. At times the 50-ton jacks were working practically to capacity with extension pipes over the jack handles and three men to each jack. The thrust was, of course, severe and the posts of the jacking bent tended to lift. It was recommended that in future work of this heavy nature, a concrete abutment be built or a crib filled with lean concrete be used. It should be kept low so as not to interfere with the flow of water after the pipe is in place. It could be designed as part of the headwall and apron of the finished structure.

The average cost of the job was $24.51 per foot. The costs were as follows:

Cost of getting material on job and erecting bulkhead	$ 267.80
Cost of tearing down bulkhead and digging inlet and outlet ditch	223.05
Actual supervision and cost of digging and jacking pipe	2,494.31
Total supervision and labor	2,985.16
Garage payroll, including equipment and operators	233.20
Equipment rental (trucks, compressor, etc.)	554.97
Miscellaneous costs (lumber, rope, wagon, lighting fixtures, pulleys, bolts, spreaders, angle irons, etc.)	282.58
Total cost of 36 in. pipe 204 feet long	994.52

County Unit Control of Roads

NINE advantages of the County-Unit plan for control of all roads outside of state systems are summarized as follows in the report of the sub-committee, of which Allen M. Williams, County Engineer, Ionia County, Michigan, is chairman, presented at the 1937 convention of the American Road Builders' Association.

Principal advantages of the county-unit plan, abundantly supported by the evidence the committee had gathered, may be set forth as follows:

1. In the absence of a unit plan of operation, all or a large part of the road work suffers from the lack of trained personnel, under the supervision of a qualified engineer. There are some exceptions to this. A wealthy township, for example, may enlist the services of an engineer. In New York the elected town superintendents and in Illinois the elected township highway commissioners are supervised, to a greater or less extent, by the county superintendents of highways, and proper cooperation has brought good results in many counties. But, in general, the township and district units will not or cannot support the engineering direction necessary if the road work is to be managed efficiently and carried out to proper standards, and if advantage is to be taken of the new funds of knowledge that highway research has made available.

2. Adoption of a county-unit plan makes possible full-time use of road machinery, with the result that the advantages of mechanization of road work are more fully realized. The small district and township units usually cannot afford to own the equipment necessary to do effective work; if they do have the equipment, it is idle too much of the time.

3. With the more stable and capable organizations developed under a unit system, advance planning of local highway programs is encouraged. An example of the advantage of this is found in the utilization of the emergency work-relief funds provided in the past few years by the federal government. Counties with planned programs worked out by engineering organizations unquestionably derived more permanent benefit from the emergency undertakings.

4. Operation of the county as a unit broadens the tax base, and tends to equalize the burden of supporting local roads that falls on the people of the county.

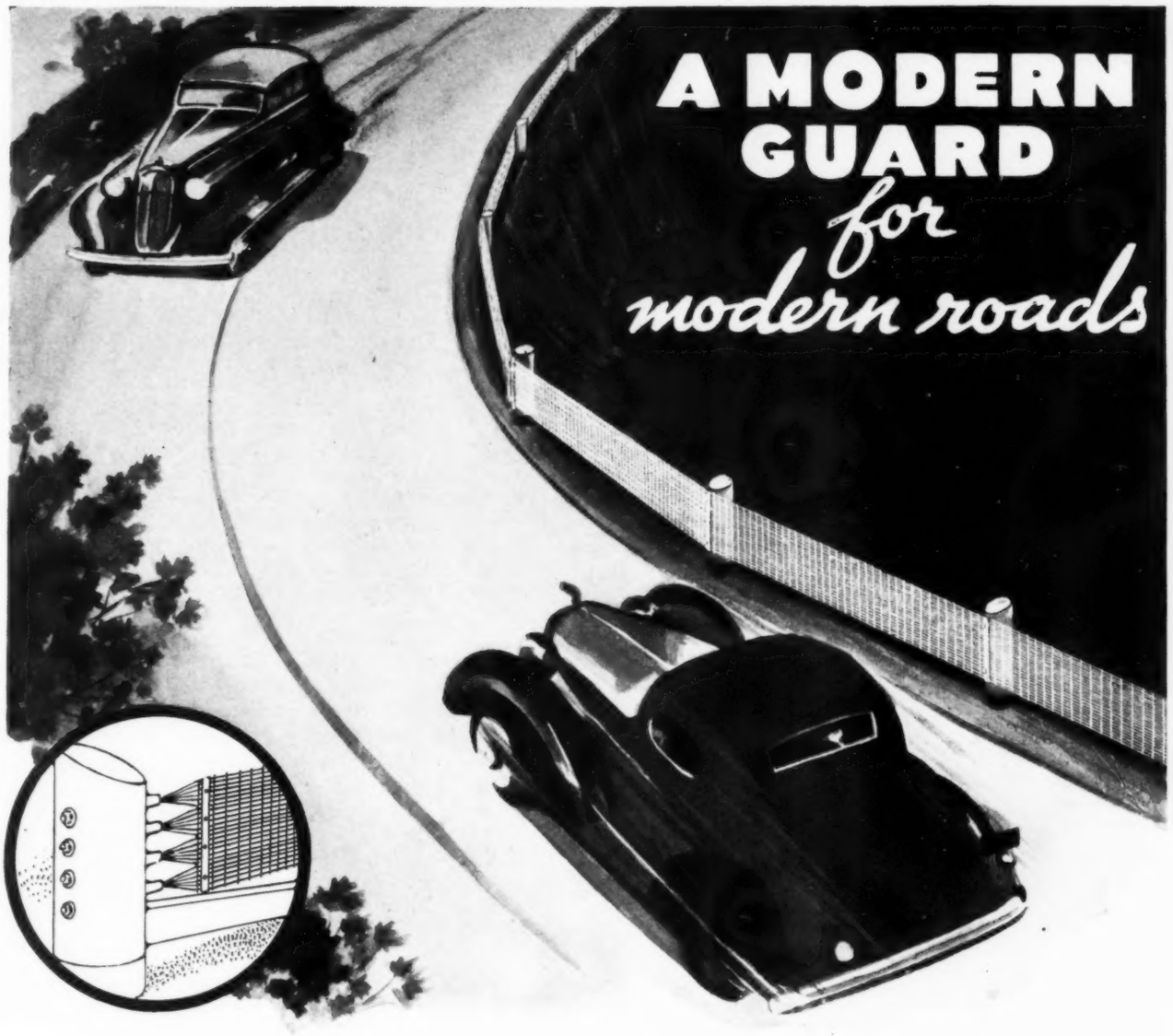
5. The county-unit plan promotes a beneficial cooperation between the local road authorities and the state highway department. Likewise, a policy of federal grants in aid of secondary roads is likely to bear more good fruit where, regardless of the intermediary organization, capable county road departments are prepared to be partners in the enterprise.

6. Breaking down township and district lines results in greater economy in maintenance operations.

7. Higher standards of construction prevail under a unit plan; there is less ineffectual patchwork road-building. More permanent benefit results from the expenditure of road funds.

8. Budgeting of funds and the keeping of cost records are as definitely associated with a county-unit system as they are rare where the extreme decentralization now characteristic in many of the states prevails.

9. A unit system makes possible quantity purchases of materials and supplies.



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By JAMES S. BURCH
Engineer of Statistics and Planning
North Carolina State Highway Commission

IN many ways, the state highway systems represent the most important and most generally used utility in a state. In this utility, the people at large are the common stockholders, the motor vehicle owners are the preferred stock holders, the legislature is the board of directors, and the governor is the president of the utility. The motor using public are both the consumers who buy the highway service, and the stockholders who profit from the efficient operation of the service.

Most highway students will agree to the proper consideration of a highway system as being a public utility in the broad sense of the term . . . a utility owned by the commonwealth, and operated for profit to the people. While these profits do not appear in dividend checks, profits are, none the less, real, taking the form of savings in vehicle operating cost, savings in time of transportation, and savings in the cost of doing business; as well as adding to the comfort and the breadth of life of our people.

Every large utility employs two forms of accounting to control operation over a long period. The first type may be termed *"Fiscal Accounting,"* which is concerned simply with keeping records of the current income, expenditures, and balances to the extent required by law and good accounting, to protect the public interest against losses due to gross mismanagement and malfeasance. There is no doubt that every state highway department employs this form of accounting to an adequate degree.

The second type of accounting employed by other utilities may be termed *"Cost Accounting."* This is the type of endeavor in which most highway departments are deficient, and is the type which is being needed more and more by state highway officials. This effort involves a measurement of the efficiency and worth of investments in plant and service, and the evaluation of the resultant accomplishment. No public utility could or would long operate in the absence of this fund of factual knowledge.

Current Importance.—Lest the importance of this effort should be unduly minimized, let us direct our attention to the current need in the highway field for this type of accounting. Let us consider only the immediate need for this work with respect to legislation and current trends being felt throughout the country. To do so, we will go back a few years and develop something of the background for these trends.

During the "Twenties," we witnessed a period of intense highway investment. Public sentiment was decidedly favorable to more and better highways. The need for rigid economy and efficiency was engulfed in band-wagon sentiment to get the traffic out of the dust and mud, and to keep pace with the automotive sales curve. Excess investment was only temporary because of the ever increasing highway demand. With the 1929 debacle, the pendulum swung in the opposite direction, and rigid economy—even wasteful economy was the order of the day. Faced with individual financial stringency, our people accepted a fallacy which they believed to be a truth; this belief being that an improved road would last indefinitely and might well be forgotten. The catch-phrase "Highway Holiday" was heard on every side, and serious inroads were made into the previously inviolate highway funds by desperate and fund-hungry agencies of local and state government. In fact, had it not been for the financial aid of the federal government, there is no doubt that the highway situation would have been very sad indeed at the present time.

Now, although motor vehicle revenues have improved, and are improving, we find that the same general attitude of the public and its leaders prevailed with respect to the future of highways. This attitude involved several erroneous viewpoints which may be briefly expressed somewhat as follows:

(1) That our highway system is fully sufficient for present and future needs.

(2) That our high type pavements are imperishable, may be accepted as accomplishments, and may be completely forgotten, except for casual maintenance to retain comfortable riding qualities.

(3) That gasoline is taxed higher than any other consumer commodity; that high taxes resist progress and mitigate against more extensive travel; that the motor vehicle is doubly taxed, as property, and for license plates.

(4) That other responsibilities of government, such as schools, employment relief, public welfare, etc., are in more definite need of funds than are our highway systems.

These considerations, if accepted as the whole truth by the public, lead up to one definite and otherwise reasonable decision; namely, increased diversion of motor vehicle revenues to non-highway purposes.

Evaluate Facts.—Highway officials realize full well the fallacy of this attitude, and it is unnecessary to present to highway engineers the errors in these viewpoints. In fact, any *informed* and reasonable person will discount these statements as erroneous or only half true. Therefore, we come to the crux of the highway situation as it seems to exist today. The need of the hour is to determine and evaluate highway facts through

• Moving acres of earth, rolling tons of steel, drilling deeper oil wells, harvesting grain, transporting materials and building them into finished products, or just out for a drive —the chances are that Hyatt Roller Bearings are there, so broad is the range of Hyatt bearing sizes and applications in industrial equipment, farm machinery, and motor cars.

Turning wheels, shafts, and gears in every service, owe their power and maintenance conservation to Hyatt Roller Bearing design, precision, and strength. Masters of bearing manufacture and application, Hyatt engineers and craftsmen are competent to meet all your requirements. Hyatt Bearings Division, General Motors Corporation, P. O. Box 476, Newark, New Jersey.

Contractors' equipment builders like **THE OSGOOD COMPANY,** whose Shovel is illustrated, have found that Hyatt Roller Bearings add many extra years of serviceability to their machines. It will pay you to specify Hyatts by name on all equipment purchases.

HYATT
ROLLER BEARINGS

logical accounting methods, in order that our stockholders, the people, and our boards of direction, the legislatures, may be properly and adequately informed of the fundamental facts in the highway situation. To the extent that these facts are not available or not promulgated; to that extent do we risk resultant ill advised legislation and administration.

Education Necessary.—Engineers, generally, do not wish to employ propaganda, nor to engage in lobbying or in campaign activities. However, as public servants, we are charged with the duty of acquainting our employers, the public, with the facts, and our best appraisals and forecasts. It is the opinion of the writer that the general public is prone to adopt an attitude of "laissez faire" with respect to highways, and it would appear most timely that a complete and well directed program of education be adopted at the present time.

The railroads, the power companies, and all of the so-called utilities find it necessary continually to take stock of the results of their activities, to appraise their plant, their investment, and their service, and to set-up and expend funds for the replacement of facilities as may become necessary due to any cause. Yet, because of the long life of most highway investments, these elements are seldom considered in modern highway accounting.

Depreciation and Obsolescence.—Depreciation and serviceable life of our pavements are vital factors in accurately employing the annual cost formula. It is indicated that annual depreciation is about three times average annual maintenance costs. A highway investment has its parallel in the investment in any other plant or in a private dwelling. For instance, let us look for a moment at this picture.

We built our house during the early "Twenties," and we have done a fair job of keeping it painted and leakproof during those years; but if we are foresighted, we do not assume that the house will last a lifetime in a satisfactory condition. Rather, we anticipate and prepare for the time in the future when the house will no longer be suitable for our purposes, and the day when reconstruction or abandonment may be necessary.

The house may become insufficient, due to needed space for our enlarging family; it may become unsafe, due to our increasingly careless manner of living; it may become unsatisfactory, due to internal decay or normal disintegration; and last but not least, it may become unacceptable, as most houses do, simply because it is obsolete, and not located and designed to accommodate our further needs.

Applying this parallel to our highways, how many of us can state definitely the "net worth" of the various portions of our highway plant; the proper annual "write-off" for depreciation and obsolescence; the future annual income needed to perpetuate our present plant, adjusted to future requirements without additions? These are the type of fact which are vitally needed at the present time. We generally use best judgment to estimate the value of these elements; but we need actual facts, rather than judgment, to properly obtain efficient highway administration in the years to come. We need to look forward.

We no longer have the old band-wagon sentiment for unlimited highway investments. Instead, we have a rather satisfied and tax-conscious average citizen, who looks us squarely in the eye and says "we are satisfied with our roads, we see no cause for concern about the future, why not decrease motor vehicle revenues, and divert large amounts of these funds to other needed purposes?" It becomes our duty, as public servants, to determine the basic facts and to acquaint our public with those facts, whatever they are, in order that they and their representatives may arrive at well advised decisions. First, however, we must get at the job of obtaining the facts.

Use of Accounting.—Not only may such an accounting system be used to guide our legislation and the determination of general policy—but, in combination with other facts, it will aid us in our every day problems.

It is naturally assumed that our fiscal accounting will disclose the annual maintenance cost, for each section of road and that our traffic studies will develop pertinent data as to volume, and type of traffic, origin and determination of traffic and the purpose of road usage.

With these facts, we may arrive at decisions with respect to the wisdom of relocations, types, and widths of surfacings and bridges, priority of improvement and the need for future highway service. A given highway may be considered, not only as a unit, but also, as an integral part of a network of highways. What is done at a given point may affect, and may be affected by, situations 100 miles or more away. Industrial and population trends are closely allied with the highway service, and have a bearing on policy and on specific decisions. While some of these elements are indeterminate from the mathematical standpoint, they can and should be given thorough consideration in specific cases and questions.

At any rate, we should be able to evaluate those elements subject to definite appraisal, and to make logical forecasts. The facts which may be obtained from cost accounting are primarily those which deal with original cost, maintenance cost, life, rate of depreciation, replacement cost and salvage value.

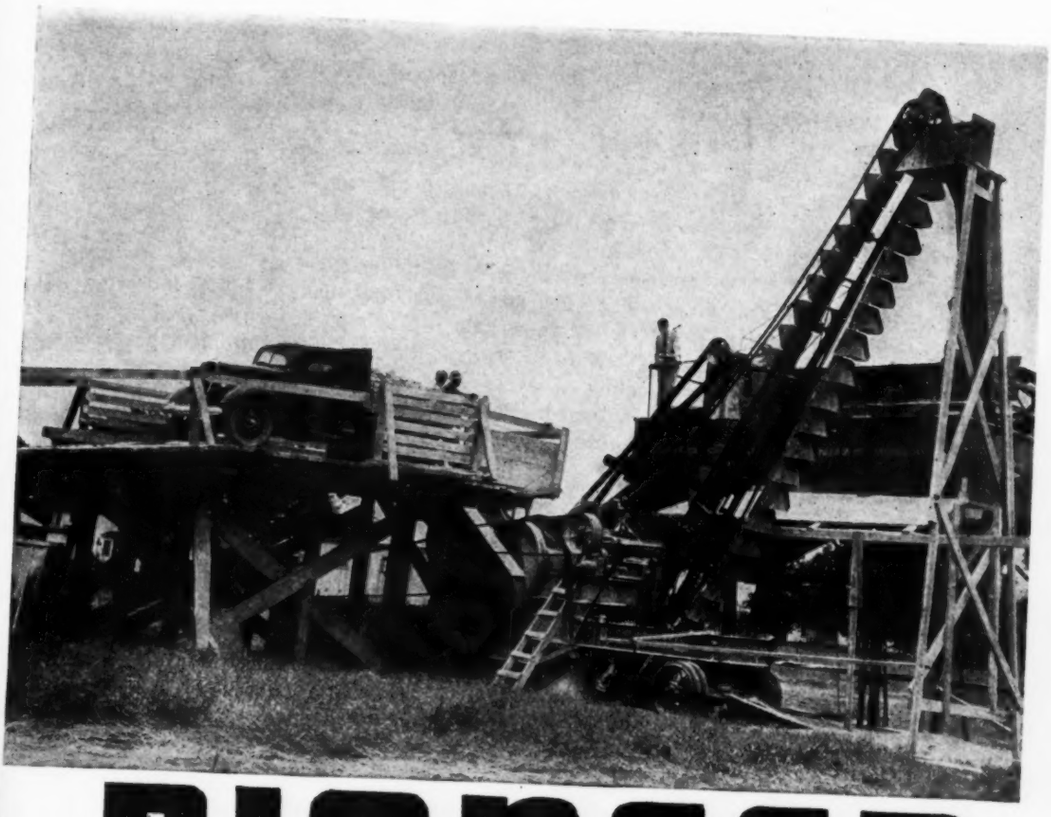
Uniformity.—It is obvious that uniformity in these costing systems is highly desirable as between the states. Only by comparison of the cost of a unit of highway service, with similar data in another state, may the degree of efficiency of administration be gauged. We hear the statement, for instance, that a certain state furnishes 2,000 miles of high-type road on a 3 ct. gas tax, while another furnishes only 1,000 such miles on a 5 ct. per gallon tax.

In the absence of further facts, such statements have no bearing on the relative efficiency of the states. In fact, the state with the high rate may be doing a better job. Only through uniform cost accounting and related studies may the efficiency of policy be appraised.

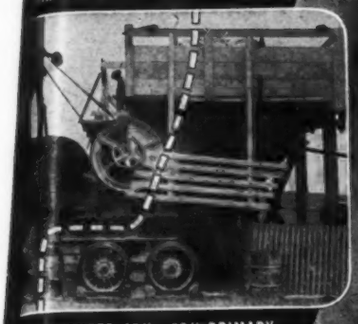
Not being an accountant, and confessing to no special vision in the execution of the task of designing a cost accounting system, I do not propose to attempt here to outline such a system. My purpose is limited simply to the outline of my viewpoints as to the needs, and some of the uses.

It may be pointed out that there are certain obstacles to the adoption by all the states of this form of accounting. First, it often represents somewhat of an innovation and may be met with an attitude of lethargy. Second, legislatures are not always prone to finance efforts which may appear to them to encroach upon their prerogative. Therefore, in many sections, we may have the additional task of acquainting our people and their chosen representatives with the need for such studies as a regular accounting procedure.

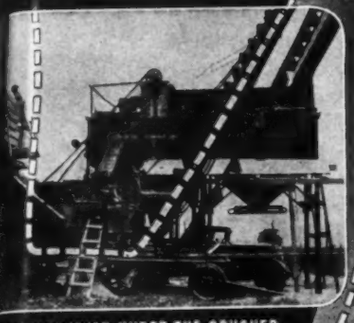
HERE'S HOW . . . LA CROSSE COUNTY, WISCONSIN, PRODUCES 4 SIZES OF CRUSHED LIMESTONE . . . .



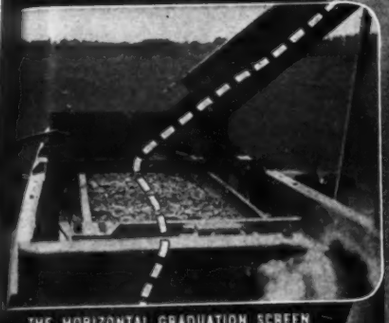
RED ROCK IS DUMPED INTO A HOPPER WITH SLOPING BOTTOM . . . THEN



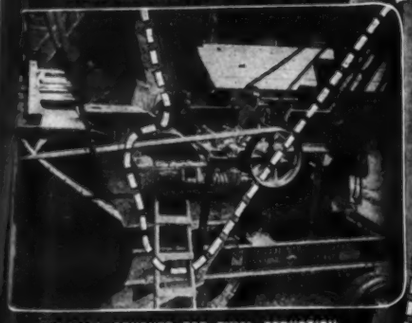
TO A PIONEER 15" x 36" PRIMARY JAW CRUSHER . . . ONTO



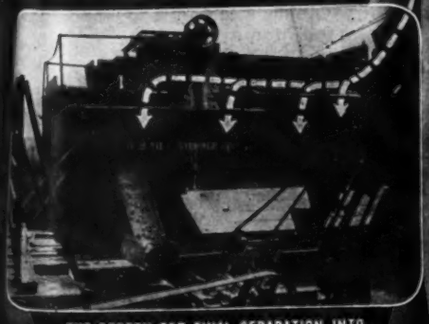
A BELT CONVEYOR UNDER THE CRUSHER AND UP THE BUCKET ELEVATOR . . . TO



THE HORIZONTAL GRADUATION SCREEN WHICH SEPARATES FOUR SIZES OF STONE AND SEND THE OVER SIZE TO



THE ROLL CRUSHER FOR FINAL REDUCTION . . . THEN UP THE ELEVATOR TO



THE SCREEN FOR FINAL SEPARATION INTO THE FOUR COMPARTMENTS

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Job Output . . 8 Days . .	3770	cu. yards
Maximum Daily Output . 8½ Hrs. . .	594	cu. yards
Average Hourly Output	67.3	cu. yards

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Highway Commissioner

THESE FIGURES ARE FROM THE RECORDS OF THE LA CROSSE COUNTY HIGHWAY COMMISSION

La Crosse, County, (Wisconsin) requires three sizes of rock for road surfacing:

No. 1, base course, 2¼ in. to 1½ in.

No. 2, key rock, 1½ in. to ¾ in.

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- **The fines (⅛ in. minus) are sold to the farmers for agricultural limestone.**
- **All sizes are produced simultaneously in the Pioneer 245R Duplex Quarry Plant.**
- **Tell us your crushing problems. Our experienced service organization is always ready to help you. Send the coupon today. There is no obligation.**

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Pioneer Gravel Equipment Mfg. Co.
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We are interested . . . send us information.
Quarry plants . . . jaw crushers . . . roll crushers . . . horizontal gradation screens . . . conveyors.

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EDITORIAL

Post Old Bridges

HAVE state highway and county engineers investigated the legal responsibility, in their various states, that rest upon them, as public highway officials, as regards old highway bridges? All engineers are aware of the rapid strides that have been made in the heavier loading of trucks. Modern motor freight units are overstressing standard H-15—A.A.S.H.O. loadings as high as 60 per cent in some bridge members.

It is miraculous how some of the old wooden structures are still standing. The "last straw" for them has not been placed. The problem is serious.

Arguments have been advanced to cut the size of trucking combinations below what is now using the roads. It is doubtful if this can be done because usage, in a way, will determine future legislation on limiting restrictions.

It is relatively easy for a highway engineer to say that because the various states and counties have billions of dollars, in the aggregate, tied up in bridges, they can restrict loads that are detrimental to the structures. Besides being a backward step, we wonder if those engineers have calculated the investment in motor freight units that use these roads? We think it will be discovered that the two investments are nearly alike. Since common usage, to a large degree, determines limitations when restrictions are to be established it is doubtful if the trucking interests would permit putting some of their units out of operation. Enough political pressure could be brought to bear on the highway departments to prevent this occurrence. Therefore, the time has come for engineers to take remedial steps for the protection of bridge investments that may fail under excessively heavy motor transport units.

California recognizes this serious problem and is posting its bridges for maximum allowable loads for various types of hauling units.

This activity has many ramifications, not the least of which is the engineering rating basis for old bridges. An important part of the rating specifications is the reduction of the factor of safety, or what amounts to the same thing, an increase in allowable unit stresses above those commonly accepted for design purposes. For this kind of engineering practice to stand the test of a court case, engineers should be in common accord on the fundamentals. This means that composite competent engineering judgment is necessary in constructing a standard specification for rating old bridges.

Naturally, those engineers most competent to devise a set of standard rating specifications for posting old bridges are bridge engineers who have specialized in highway bridge design, inspection and construction.

Rating standards for posting old bridges is a big problem and the A.A.S.H.O. committee working on it needs all the factual information from tests, research or experience that can be placed before it.

Irate operators or citizens often will say, "Why don't you fix them? With all the money the state gets for highway work there's no reason why the old bridges shouldn't be fixed so we can haul full loads." But there they are mistaken. There is a reason. Highway income is not adequate to meet the demands of transportation. To fix a couple or more hundred old bridges will require foregoing construction of a road to some scenic point. When this is suggested opposition from other sources arises to see that the proposed highway is built.

▼

Port of Entry

THE following letter from the Montana Contractors' Association, makes it clear that at least one western state has ports of entry with functions quite different from those criticised in our July editorial under this same heading. We are glad of the opportunity which Mr. Roscoe has given us to pass this word along.

We might add that a statement in a recent issue of "Automobile Topics" indicates an easing up on border restrictions due to widespread public criticism.

Gillette Publishing Company.

Gentlemen:

Reference was made in an editorial in your July issue of ROADS AND STREETS on ports of entry stations.

While no reference was made directly in this article to the state of Montana, for your information the State Highway Department maintains during the summer months a number of these stations at strategic points on our main highways for the purpose of assisting and aiding non-residents in their trips through the State. A polite request is made by a sign for non-residents to stop at these stations, however, no effort is made to stop cars that do not care to stop. These stations are manned by high class personnel made up of college graduates or boys going to school, and the sole purpose is to assist the tourist.

If the tourist stops, he is given all the necessary information as to roads in the state of Montana. He is also furnished with a road map or a strip map and is given any advice as to routes or roads that he may desire. There is no fee collected and all the information is put out with a smile.

These stations are conducted for the sole purpose of assisting the tourist. The only thing the Highway Department gets out of it is records kept at each one of these stations as to the number of cars entering the State, the number of people in the cars, the State Highway Department using this information through their planning board to lay out their highways and to take care of future anticipated construction. I might add that each tourist car is supplied with a stamped postcard which he is requested to indicate thereon upon his leaving the State any suggestions he has to make to improve road conditions or any other thing he might have to offer. This department has nothing to do with gasoline bootlegging or stolen cars, which is taken care of through the regular Highway Patrol.

I would suggest if at some time you know anybody making a trip into this State have them check up on our courtesy stations and advise you.

We are strictly in accordance with your idea of additional assistance being given the western states in construction of highways for the reason that our populations are small, our revenue not large, and our distances great. The average person does not realize that the State of Montana is over 700 miles across east and west and 400 miles across north and south and our larger towns at which tourists stop probably average from 75 to 100 miles apart.

Trusting this information may enlighten you, we beg to remain

Yours very truly,
Montana Contractors Assoc.,
W. P. Roscoe, Pres.

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Two men, a tractor and an Insley Shoulder Finisher will grade and finish both sides of a mile of roadway in one day . . . every day (weather permitting) . . . and always a perfect job. This means one important thing . . . low cost.

There is a size and model INSLEY to handle every type of shoulder finishing. Write today for complete specifications and prices.

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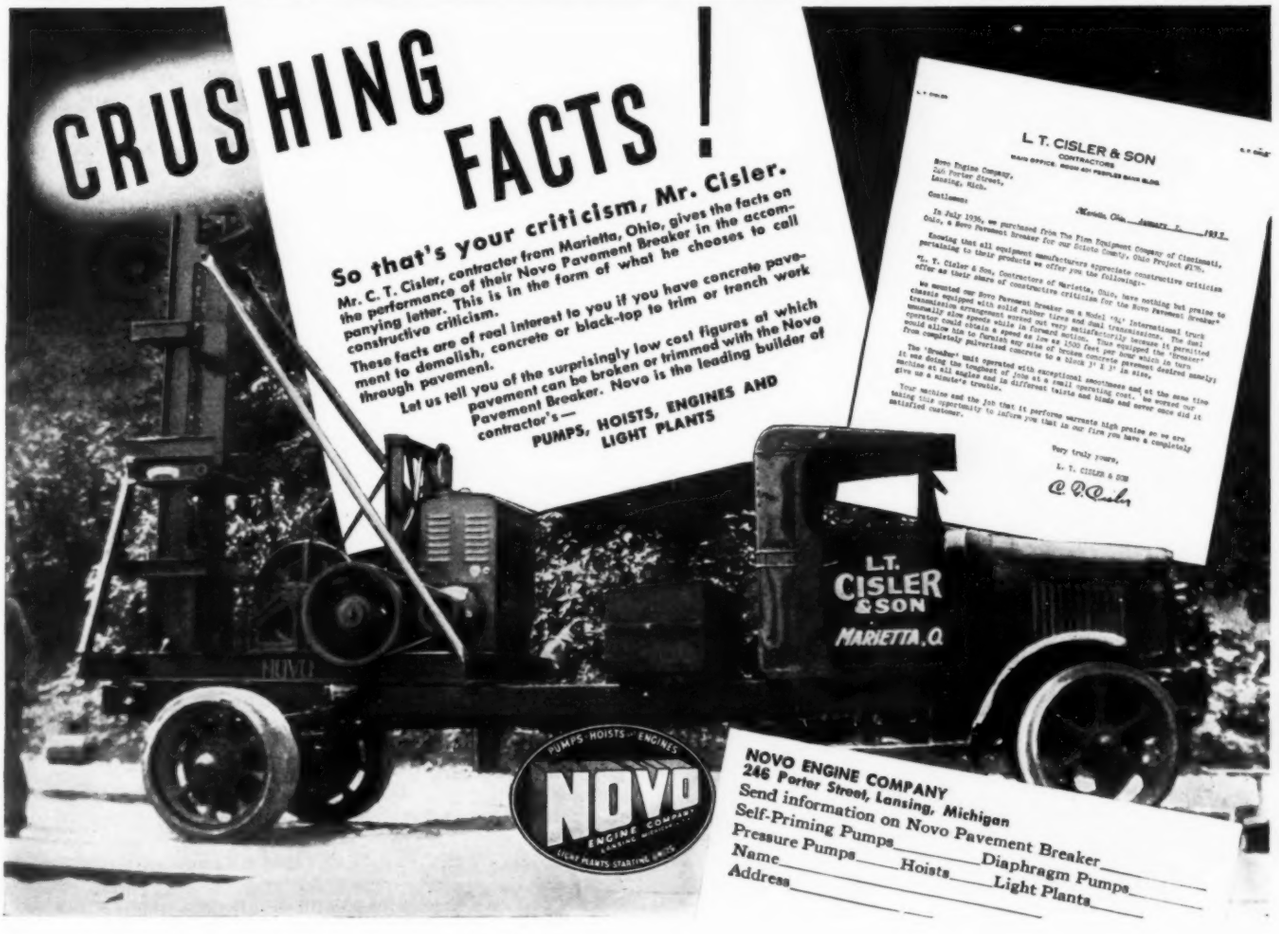


NEW LITERATURE

Tractors—An attractive new catalog has been issued recently by Allis-Chalmers Mfg. Co., describing their Model "LO" oil tractors used by contractors, highway departments and loggers. Large, clear-cut illustrations are used throughout the catalog showing action scenes, cross-section views and features of construction such as controlled alignment, track construction, controlled ignition and unit construction. The controlled ignition Diesel fuel burning engine used in Allis-Chalmers equipment is described in a concise, understandable manner. A copy of this interesting catalog can be secured from Allis-Chalmers Mfg. Co., Milwaukee, Wis.

Welded Piping Design—Complete handbook information on design and layout of piping for welded connections is contained in "Design of Welded Piping," a 200-page (6x9) booklet containing over 100 figures and tables, published by The Linde Air Products Co., 205 East 42nd St., New York, N.Y. Subjects treated of interest to engineers are fundamentals of welded joint design; welding metallurgy; standard welded pipe connections; design data on welding cast iron, galvanized iron, stainless steel and non-ferrous piping; advantageous layout; fabrication and erection considerations; welded anchors and supports; and welding speeds. Features of interest to architects and draftsmen include standard joint designs; typical headers, expansion bends and riser connections; anchors and supports; a typical heating system layout showing symbols for welds; two sample time-saving specifications; and principal dimensions of pipe, flanges, and welding fittings.

Hose—Electric Hose & Rubber Co., Wilmington, Del., have just produced a new 64-page catalog of their complete line of braided and molded hose. This book has been carefully prepared for the convenience of the user. The data and helpful information is indexed according to "purpose" as well as kind of hose. A loose-leaf form and pocket size also contribute to convenience. The catalog will be furnished to all who write for it on a business letterhead.

Lufkin Tape and Rule Booklet—A neat, light weight, pocket size booklet showing measuring tapes and rules of only such patterns as are used by engineers, surveyors, road builders and the oil industry is offered by The Lufkin Rule Co. It contains also a page devoted to tension and temperature standards, standardization, etc.

It is not intended to entirely take the place of Lufkin complete General Catalog No. 12, which is suitable for standing in a file. However, the new booklet will be welcomed by those engineers, surveyors, oil gagers, etc., who wish information on tapes and tape accessories always at hand. Known as "Engineers Tape and Rule Booklet No. 2," it will be sent to interested parties on request by The Lufkin Rule Co., Saginaw, Michigan, or 106 Lafayette St., New York City.

Vibrator Bulletin—"Branford Vibrators and Accessories" is the title of General Bulletin "C" just issued by the New Haven Vibrator Co., New Haven, Conn. This 58-page publication contains illustrations of vibrators and a wide range of connections and other accessories for many different uses. It also carries a complete price list of all items shown, and a three page list of distributors who handle it. Short specifications are included.

Bullgrader and Bulldozer Bulletin—Bucyrus-Erie Company, South Milwaukee, Wis., has issued a snappy folder describing and illustrating its Bullgrader and Bulldozer for T-20 TracTracTor. General specifications are included, and eleven items of construction and operation are given special reference. The bulletin is the very latest publication regarding such machines.

Diesel Engine Application—"Places for Power Supplied by 'Caterpillar' Diesel Engines" is a new booklet issued by Caterpillar Tractor Co. Made up in the usual "Caterpillar" style, the booklet features clear illustrations and concise captions, pointing out the advantages and the economy of Diesel engines in each case. Pumps, mines, hoists, sawmills, flour mills, generator sets, ice plants, oil wells, cotton gins, rock crushers, dredges and general construction work are just a few of the specific applications which the booklet discusses. More than 100 examples are mentioned. The booklet may be obtained free of charge by writing Caterpillar Tractor Co., Peoria, Ill. The form No. is 4127.

Link-Belt Book on Power Transmission Pulleys. A new 8-page illustrated list price Book No. 1622 has been completed by Link-Belt Company, Chicago, on the subject of cast iron pulleys for power transmission, giving pertinent data on solid and split, single and multiple arm machine-molded pulleys, with and without rubber lagging.

A copy of the book will be mailed to any interested reader upon request, which may be addressed to the nearest office of the company.

Specifications for Placing Reinforcement.—The "Code of Standard Practice and Specifications for Placing Reinforcing Materials" of the Concrete Reinforcing Steel Institute, 201 North Wells Street, Chicago, Illinois, is just off the press.

These standards were first developed about ten years ago and formed portions of the Institute handbook "Reinforced Concrete" which is now out of print. They have recently been brought up to date and are now printed separately so as to supply the frequent demands for the standards of this industry.

As a reliable reference in matters relating to the use and application of reinforcing materials, the Code of Standard Practice provides a publication of very definite value to the three parties involved on a construction job—the specifier, the buyer and the seller.

Copies of the Code are available without charge upon application to the above address.

Earthmoving Equipment—A 20-page bulletin giving a pictorial presentation of the use of Le Tourneau equipment in handling earthmoving jobs has been issued by R. G. Le Tourneau, Inc., Peoria, Ill. The illustrations and descriptive matter cover earthmoving jobs from clearing to the final subgrade.

Truck, Bus and Tractor Operators Handbook—Prepared in a new and much more convenient form than ever before, and containing additional new and up-to-date information valuable to owners and operators of trucks, buses, tractors or farm implements and industrial equipment on which rubber tires are used, The B. F. Goodrich Company has just published the 1937 edition of its "Operators' Handbook." Copies are now available upon request to the company at Akron, O. The new volume contains 66 pages, filled with factual information and data tables on tires in commercial services. Complete description of all the company's tire and tube products for trucks, buses, tractors or farm implements with specification tables giving detailed data are included. The Goodrich Calculator, to tell actual truck tire costs is described and instructions given for its use. Much new information is given in the chapter on "Load Ratings and Inflation Pressures," in which the maximum load which can be carried by any tire depending upon operating conditions is discussed. Two pages treat easy methods of load analysis and a description of the importance of such analysis for efficient and economical operation.

Caterpillar Products—"Caterpillar" tractors, road machinery and engines on various types of construction jobs are the subjects of a new booklet, just issued by Caterpillar Tractor Co. Featuring illustrations, the booklet gives a pictorial record of the many types of construction jobs for which "Caterpillar" equipment is suited. Equipment mounted on tractors, tractor-drawn scrapers, rippers, blade graders, bulldozers, tractor mounted generators, stationary generator sets, wagons, elevating graders; and Diesel power for locomotives, crushers, dredges, hoists, and shovels are just a few of the items with which the book treats. The 32-page booklet may be obtained free of charge by writing Caterpillar Tractor Co., Peoria, Illinois. The title is "On Construction Jobs With 'Caterpillar' Products," and the Form Number is 4198.

Scrapers—The Bucyrus-Erie 2-wheel and 4-wheel scrapers are described and illustrated in bulletins just issued by the Bucyrus-Erie Co., South Milwaukee, Wis.

Welding in Construction Work—A new bulletin has just been issued by The Lincoln Electric Co., Cleveland, O., illustrating a variety of applications of arc welding in the structural field, both in the erection of miscellaneous structures and in maintenance work of construction machinery.

The new bulletin, "Welding in Construction Work," contains 12 pages, 8½ in. by 11 in. It is a record of the more important recent construction projects which utilized electric welding.

NEW EQUIPMENT AND MATERIALS

New 5-yd. Tractor Scraper

A new 5-yd. tractor scraper has been announced by the Austin-Western Road Machinery Co., Aurora, Ill. Surpassing the performance of the widely accepted and popular scraper it replaces, this new model (according to the manufacturers) loads with still greater ease and speed.

Austin—Western's Newest Scraper

Like its predecessor, the new scraper uses but one cable and one lever to control all loading, carrying and dumping and is designed to work with any tractor within the horsepower range of 35 to 60.

Adjustments have been provided for varying the clearance under machine and the front door is so constructed that the pan will always get a full load. Several of these machines are already in operation and users report capacities up to 60 yds. of pay dirt per hour.

A new bulletin covering this latest model unit can be secured by writing The Austin-Western Road Machinery Co., Aurora, Ill.

▼

New Line of Truck Tires for ½ and ¾ Ton Sizes

A new line of heavy duty commercial truck tires and tubes designed especially for light trucks of ½ and ¾ ton carrying capacity is now being manufactured and sold through its nation-wide organization by The B. F. Goodrich Co., Akron, O.

The new line is manufactured in a complete range of sizes to fit present equipment rims in 16 in. wheel diameters. These sizes are 6.00-16; 6.50-16; 7.00-16; and 7.50-16. All are made with six plies, while the last is also made with eight plies.

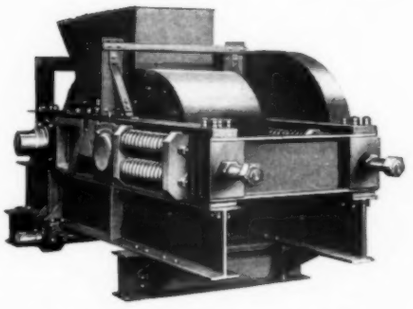
The new tire follows the development by Goodrich in recent years of the "Commercial 15" and the "Store Door Silvertown" tires, also specially designed to fit specific services in the light truck field.

For use with the 7.00 and 7.50 sizes the company has developed a new all-black tube equipped with hand-bendable rubber valves. This special tube was designed especially for speed conditions encountered in the light truck field. For the 6.00 and 7.50 sizes the manufacturer will use the Gold and Black tube, with hand-bendable rubber valves, which has had such wide acceptance in the passenger car field.

New Roll Crusher

A new roll crusher designed particularly for tough jobs has been added to the line of the Pioneer Gravel Equipment Mfg. Co., 1515 Central Ave., N. E., Minneapolis, Minn.

Power is applied to a pulley on the countershaft, then through the pinion to drive gear on the stationary roll. This type of drive permits a 6½ to 1 reduction and the countershaft travels at the proper speed for an efficient belt drive from the power. On the opposite end of the stationary roll is a star gear which transmits the power to the floating roll. This drive permits full adjustment between the roll and also allows the free action of the floating roll against the safety springs. The opening between the rolls can be adjusted for various size products by moving the floating roll. After the crusher is adjusted, the back stop wedge holds the rolls apart at the desired opening, thus preventing an axcess production of fines. The floating roll is held against the back stop wedge by eight springs four on each side). These springs have three inches of safety and protect the crusher against damage from tramp iron, foreign materials or choking. In addition to the spring release, there are four safety bolts supporting the tension springs, which will shear off before the crusher is damaged. One side of the roll hub is machined to fit tight against the tapered shoulder in the roll shell. The other side is machined to fit the tapered segments which hold the shell. This mounting is machined to give a true circle—it is self-centering—and the roll shells can be replaced without removing the bearings from the shaft. The tapered shoulder on the shell prevents any side movement. The full circle contact gives a firm hold and prevents the shell from turning on the hub.



Pioneer Super 40 Roll Crusher

This Pioneer super 40 roll crusher is 40 in. x 22 in. and weighs 18,000 lbs.

A New Adams Motor Grader For Year 'Round Work

J. D. Adams Company, Indianapolis, Indiana, recently announced a new low-priced motor grader in Adams Motor Grader No. 20. It is powered by the International I-12 tractor with 22½ h.p. engine, but a special chain drive between the tractor axle and the driven axle effects a 65% increase in pulling power of the tractor.

This new machine has been designed especially for municipal use. Although low in price, it has the refinements of the higher priced, larger motor graders such as all-welded construction, machine-finished ball and socket connections, machined full circle, etc.

According to the manufacturer, this new machine is ideal for maintaining unimproved streets and alleys, for grading and maintaining roads and runways in parks, golf courses, air ports, etc. It should also prove effective on township and light county maintenance. For winter work, a reversible blade snow plow is offered which is hydraulically controlled from the cab. This new plow adds to a long list of optional equipment such as scarifier, canopy top, enclosure, starting and lighting equipment and other accessories that may be had to make it an ideal year 'round outfit.

Standard equipment on this machine includes 9 ft. blade—10 and 12 ft. blades are optional. The approximate weight is 8,100 lbs.

Adams Motor Grader No. 20

Portable Apron Feeder Crusher Unit

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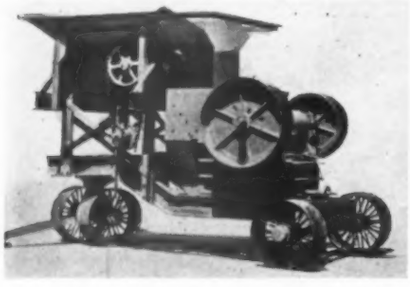

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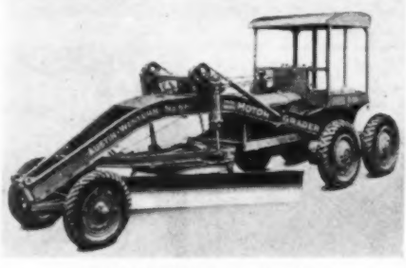

Model "66" Motor Grader

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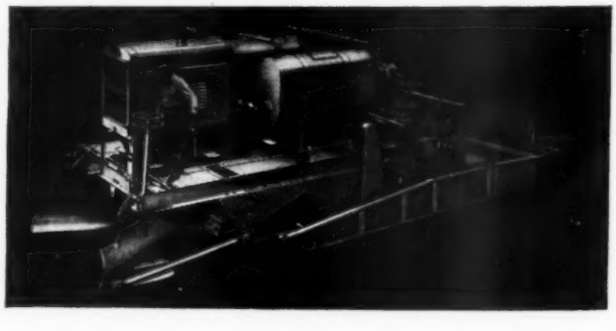
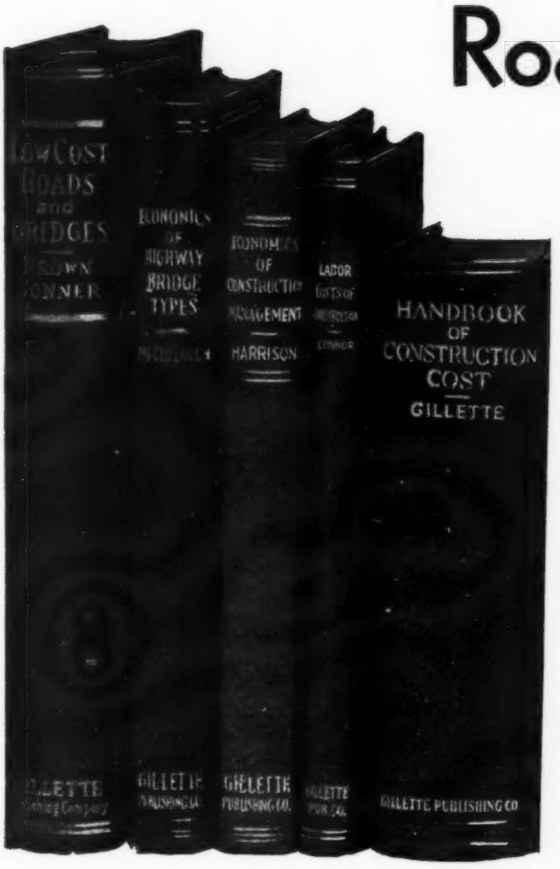


THE Road Builders' Library



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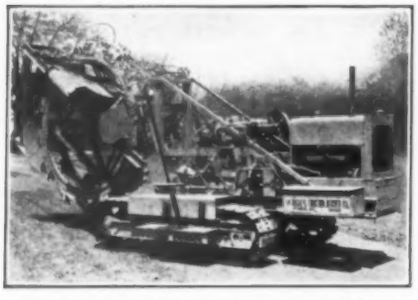
TEN DAYS' FREE EXAMINATION

GILLETTE PUBLISHING CO
400 W. Madison St. Chicago, Ill.

New Small Ditcher

The perfected Model 12 service ditcher announced recently by the Buckeye Traction Ditcher Co., Findlay, O., has been designed with the idea of providing a ruggedly built, abundantly powered small size ditcher that can be maneuvered neatly in all kinds of hard-to-get-at places.



Buckeye Model 12 Service Ditcher

The low bearing pressure of the alligator treads—approximately 6 lbs. per square inch—permits use of the machine over very soft ground and prevents damage to lawns and driveways when the machine is used for small sewer, water or other utility lines.

Eight digging speeds, all transmission controlled, are instantly available to the operator, ranging from 22 in. to 98 in. per minute. Eight more digging speeds are made quickly available by moving a feather keyed sprocket into position and adjusting the chain. Another sprocket is also furnished which further increases the digging range, giving a top speed of 23 ft. per minute.

Trench widths possible with the Model 12 Buckeye run from 15 in. to 22 in., with depth up to 5½ ft.

Overall width of the machine is 77½ in., with a length of 23½ ft.

▼

New 4 Yd. Wagon Scraper

A new 4 yd. wagon scraper known as the "Junior Continental" has been announced by the Continental Roll & Steel Foundry Co., Tractor Equipment Division, East Chicago, Ind. Designed for use with smaller 35 to 50 H.P. Crawler tractors, the new 4 yd. model is the same in general design and operation as the larger Continental models.

The manufacturers claim that their new 4 yd. wagon scraper is light in weight without sacrificing the ruggedness necessary to dig, load and haul capacity loads of tough clay, rock and tree root imbedded soil, shale, hardpan, etc. Other features of the 4 yd. junior model are high axle clearance, a large fast dumping rear gate, the new Continental BE-GE hydraulic power control unit with adaptors for all tractors of 35 to 50 H.P., shorter overall length for easier turning, and a wide cutting blade, the width of cut being the same as that of the 5 yd. size.

Junior Continental 4 yd. Scraper

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A New Tamper

An explosion type tamper weighing 220 lb. has been announced by The Calhoun Co., of 1151 South Broadway, Los Angeles. Superior compaction, ease of operation and economy are features claimed for this machine. Quickly changed bases convert it from a tamper to a hammer for driving piles and sheeting. Other bases are available which adapt the machine to concrete breaking, concrete tamping, also tamping of gravel roadways and cobble stones.

The low center of gravity makes this machine very easy to handle. It may be controlled with one hand only.

The Delmag Tamper

A New 3½ Foot Mixer

The Knickerbocker Company of Jackson, Michigan, announces a new "tub type," 3½ cu. ft. concrete mixer, embodying several design features generally found only in machines of greater capacity. To the one-piece, cast, semi-steel drum bottom is riveted a 6 in. heavy steel band to which is riveted the drum cone, reinforced around the top with a steel tire.

Bearing details have had special attention, as experience has shown that mixers of this type are peculiarly susceptible to bearing troubles. The drum shaft is 20 in. long, revolves with the drum, is held in position by a large nut, and has two long bronze bearings, one at the top and one at the bottom of the yoke. Total bearing area is 5 in., with large lubricant chamber between the two bearings. A Timken thrust bearing takes up the thrust of loaded drum and is completely sealed from water and grit. All bearings have Dot lubrication.

Knickerbocker Company's New Tub-Type Mixer

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New Road Striping Outfit

A new road striping outfit recently placed on the market by the Binks Manufacturing Co., 3114 Carroll Ave., Chicago, Ill., is offered with two different styles of mounting—the trailer type for the rear end of a truck, and the running board type shown in the illustration.

In the trailer type mounting the upright mounting post has an adjustable clamp for various heights. This is bolted to the truck floor. Special spring tension joint frees outfits from truck jars and rubber tires absorb road bumps. The hand operated valve can be mounted in any convenient position for operator. Compressor should be at least 3 H.P. and is usually mounted on skids to prevent moving from side to side in truck.

The running board type mounting clamps to the running board as illustrated and is adjustable for various heights of running boards. The operation of the striper with this type mounting permits traffic to carry on as usual. Can be attached to either right or left running board.

Binks No. 37 Road Striping Outfit

New Blast-Hole Drill

Newest in the Bucyrus-Armstrong line of blast-hole drills is the 27-T, just introduced by Bucyrus-Erie Co., South Milwaukee, Wis. The new drill rig weighs 18,400 lbs., and has a tool capacity of 2,000 lbs.

So immediate has been the demand for a modern drill of this size and capacity that a number of these machines have already been shipped for use by large mine and quarry blast-hole drill operators. The performance of the first of these machines in its first month on the job is stated to have shown that it drilled 4544 ft. of 6-in. hole through iron ore and Taconite at a per foot operating cost of only 11 ct., a figure that includes all power, labor, and supply costs. Daily production is stated to have been more than 200 ft., with holes averaging about 22 ft. in depth.

Outstanding exclusive features of the new 27-T include, as regular or optional equipment, a new built-in tool wrench, special bumper reel, large operator platform and other operator conveniences, rubber-insulated tool guide and sheaves, rubber shock-absorber under the crown sheave, and a fast, snappy, highly penetrating drilling action. The 27-T is furnished with 33 or 40-ft. derrick, caterpillar-type mounting, and a choice of gasoline, Diesel, or electric power. Full information may be obtained by writing to Bucyrus-Erie Co., South Milwaukee, Wis.

Bucyrus-Erie 27-T Blast Hole Drill

New Rex 14-S Mixer

A new stream-lined 14-S mixer has been announced by the Chain Belt Co., Milwaukee, Wis. New from top to bottom, this machine is claimed to incorporate faster charging and discharging, lighter and stronger frame, new accurate water control, and increased engine power into a machine that is radically different from the old machine. Its appearance and fully enclosed working parts are completely in line with its new modern compast design.

Charging is made faster by the use of a shimmy skip which together with the stream-lined shape of the skip discharges the batch into the drum with a free, fast-sliding action. The drum with its "up-and-over" mixing action and oversize buckets has one piece construction with the pressed steel drum heads welded integral with the center sheet. Discharging through the extra large drum opening onto the stream-lined chute, the drum is stated to be completely cleaned in seven seconds. The new Rex water system with the new vertical measuring tank and non-by-pass free way valve is unusually accurate and allows no water to dribble into the drum. Mounted on a rigid steel frame, the mixer is supported from the axles by strong coil steel springs at each wheel and has automotive type steering. It is furnished in four wheel end or side discharge types with pneumatic, solid rubber, or steel tires and its new power plant is a 25 H.P. radiator cooled gasoline engine. The Rex batch-meter and centrifugal water pump are optional equipment.

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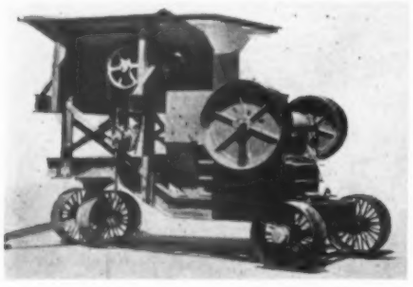

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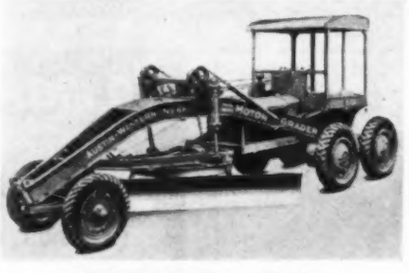

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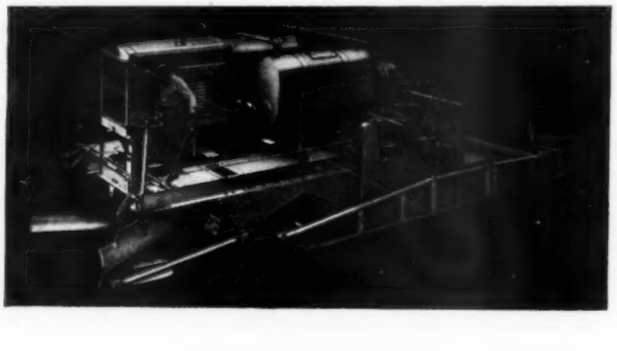
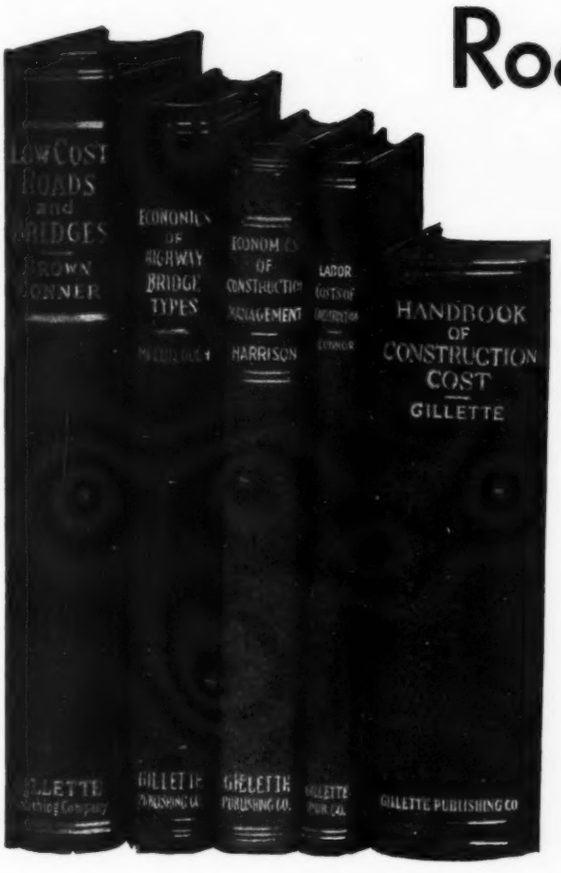


New Jaeger Mix-in-Place Road Builder

THE Road Builders' Library



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GILLETTE PUBLISHING CO
400 W. Madison St. Chicago, Ill.

WITH THE MANUFACTURERS

Thew Shovel and Universal Crane Merge

The Universal Crane Co., a separate corporation and a subsidiary of the Thew Shovel Co., Lorain, O., was merged with The Thew Shovel Co., effective June 30, 1937. Though the products of both companies have been similar, and though manufacturing plants, facilities and operations of both companies have been consolidated for several years, The Universal Crane Co. has always marketed its product as a separate corporation. This caused a series of inter-company transactions which became burdensome from an accounting and financial point of view, and ft recently seemed wise to the directors to merge the two companies, in the interest of simplification.

While a new Universal Crane Co. has been incorporated to preserve the name, The Thew Shovel Co. remains the overall company, and Universal products will be identified as coming from the Universal Crane Division of Thew Shovel Co.

Inasmuch as the products of both organizations have been marketed under the common trade name "Lorain" for the past several years, there will be no change in this respect.

Those products previously manufactured by The Universal Crane Co., consisting of ⅜ to ¾ cu. yd. units, will continue to be identified as "Universal-Lorain."

Thew products, consisting of 1 yd. to 2 yd. crawler shovels, cranes, clam-shells, draglines, backdiggers and skimmers, will continue to be identified as "Thew-Lorain" units.

The Universal Crane Co., in addition to truck mounted cranes likewise marketed a line of small crawler mounted power shovels, cranes and draglines from ⅜ to ¾ cu. yd. capacity with crane capacities as high as 8½ tons. While these products will be sold by the Thew company, the high prestige of the Universal name will not be sacrificed as a Universal Crane Division has been set up in the Thew Shovel Co.

▼

Holman H. Linn Dead

Announcement is made of the death of Holman H. Linn, Vice President in Charge of Engineering of The Linn Manufacturing Corp., Morris, N. Y., manufacturers of heavy-duty tractors. Mr. Linn was the inventor of the Linn tractor and was the founder of The Linn Manufacturing Corp. which has been manufacturing these tractors for the past 20 years. He was killed while taking off from the Morris Airport in his private airplane the afternoon of Saturday, July 3rd, and in the same crash were killed the pilot, Captain George Stead, and Mrs. Arthur Hansen. The other passenger, Mr. Arthur Hansen, was seriously injured.

FWD Installs Newest Type Equipment

Stepping up production in its Clintonville plant, the Four Wheel Drive Auto Company has purchased $125,000 in new machinery and equipment. Installation of $20,000 in heat-treating equipment for its metallurgical department is one of the big items.

Two of the new furnaces are of the recirculating type. The others are of the oven type. The new installations increase the efficiency of the FWD heat-treating methods by as much as 300 percent. Furnaces are automatic, controlled by electrically operated, temperature control devices. Installed in a central temperature control room, these machines automatically record the temperature of each oven during the progress of each load being heat-treated.

In the manufacturing department, there are numerous new lathes, drills and other machines.

An important feature is the rigid inspection of each part used in truck manufacture. To achieve even more accuracy in the inspection division, two new devices have been installed in that department. A comparator, for minute measurement of screw threads, projects an outline of the part inspected upon a chart containing the accurate outline of a master part. Inspectors thus accurately check the faults in any part so measured.

The other new inspection apparatus is a "red-liner." This device inspects gears under conditions closely approaching those of actual operation. An inking attachment records, within minute fractions of an inch, any errors in the part being checked.

▼

Hercules Makes Record Diesel Shipment

The largest single shipment of high-speed, heavy duty Diesel engines for commercial vehicles in the history of the industry has been delivered to General Motors Corporation by Hercules Motors Corporation, according to an announcement by the latter company.

The shipment of 100 Hercules DJXB Diesel engines was the first made against General Motor's production orders. The engines will be installed in Chevrolet truck chasses destined for foreign markets.

Shipped from the Hercules factory at Canton, Ohio, the engines were delivered to the General Motors Export Assembly plant at Weehawken, N.J. The units are of standard Hercules six-cylinder type, developing 77 horsepower at 2600 revolutions per minute.

▼

Tractor & Equipment Co. Opens Branch

A new branch house at 631 S. Princeton St., Springfield, Ill., has recently been opened up by the Tractor & Equipment Co., Chicago, Ill., distributors of excavating, grading and road building machinery. The building covers 10,000 sq. ft. and has full facilities of office, show room, service station, parts department and warehouse.

Linde To Build New Plant

The Linde Air Products Company, Unit of Union Carbide and Carbon Corporation, announces that work will start immediately in South Chicago, Ill., on the construction of a large manufacturing plant for the production of oxygen. The building, which will be located on Harbor Avenue adjacent to the Calumet River, will be of the most modern type of reinforced concrete, brick and steel construction. This new plant will bring the total number of Linde oxygen plants throughout the country to 70.

▼

Connelly Machinery Co. Reappointed Distributors for Bucyrus—Erie

The Bucyrus-Erie Co., South Milwaukee, Wis., has reappointed the Connelly Machinery Co., 509 North 27th St., Billings, Mont., as its distributor for the territory of the whole state of Montana except the counties of Garfield, McCone, and Valley. This firm will also cover that portion of Wyoming lying north of and including the counties of Teton, Park, Hot Springs, Washakie, Johnson, Campbell, Weston, and Yellowstone Park.

▼

New Representative for Ransome

The Ransome Concrete Machinery Co., Dunellen, N. J., manufacturers of concrete and industrial mixers, have just obtained representatives in the following territories: St. Petersburg, Fla.—Charles L. Hills, 215 16th Ave. N. E.; Selma, Ala.—Dixie Equipment Co.; Savannah, Ga.—Morgans, Inc.; Jacksonville, Fla.—Julien P. Benjamin, Inc. Also appointed—Contractors Supply Co. of Waterbury, Conn. Covering truck mixers.

▼

Armco Promotes Marvin Marsh

Marvin Marsh, special ARMCO sales representative in the Kansas City territory since January 1, 1935, has been named manager of the company's newly created district office at 7100 Roberts street, Kansas City, Mo., according to W. W. Sebald, vice-president in charge of commercial activities of The American Rolling Mill Company, Middletown, Ohio. Mr. Marsh will be assisted by a competent staff.

▼

Clifford A. Owens Dies

Clifford A. Owens, president of seven industrial concerns producing excavating machinery and tractors, died at Marion, Ohio, on July 28. He was 54.

He was head of Osgood Company, Commercial Steel Castings Company, Alloy Cast Steel Company, General Excavator Company, Hercules Company, Engineering Equipment Company and Power Manufacturing Company.

He served on the National Code Authority for shovel, dragline and crane industries during the existence of the National Recovery Act.

Kushing Now Vice President Highway Steel Products Co.

J. W. Kushing

R. R. Robertson, President of the Highway Steel Products Co., announces that J. W. Kushing, Research and Testing Engineer of the Michigan State Highway Department, joined his company July 1, as vice-president in charge of engineering. The company's general offices are located in Chicago Heights, Ill., with plants in Chicago Heights and Birmingham, Ala. Mr. Kushing will devote special attention to the highway phase of research, design and sales of the company's products.

A graduate of the University of Michigan College of Engineering with B.S.E. and M.S.E. degrees, Mr. Kushing specialized in highway engineering with a year of graduate work in cement and concrete. From 1922 to 1933, he held positions as reseach assistant of the Postum Cereal Co., Battle Creek, Mich.; project engineer of the Michigan State Highway Department; engineer in the Department of Maintenance and Ways, Pennsylvania R.R. Co.; sales engineer, Sullivan Machinery Co., in the Southern States; and as engineer of the Ford Motor Co., in the Southern States.

In July, 1933, he joined the Michigan State Highway Department, as Research and Testing Engineer. Mr. Kushing's work in the Michigan Highway organization brought him and the department recognition in highway engineering circles throughout the country.

He has been active as a member in research work of the American Association of State Highway Officials, American Society for Testing Materials, American Concrete Institute, Highway Research Board, Mississippi Valley Conference and the Montana Bituminous Conference.

In these organizations he was a member of Committee D-4 on Road and Paving Materials of the A.S.T.M.; Chairman of the Salt Committee and the Project Committe on Pavement Joints of the Department of Design of the Highway Research Board; and the Committee on Materials of the A.A.S.H.O.

During this time Mr. Kushing presented several papers on Testing and Use of Materials, including "Compaction of Fills"; "Experimental Work on Physical Properties of Bituminous Materials"; "Testing of Joints"; "Soil Stabilization with Cement, Calcium Chloride and Sodium Chloride"; "Methods and Cost of Peat Displacement in Highway Construction."

▼

Chicago Pneumatic Tool Co. Has New Buffalo Address

Chicago Pneumatic Tool Company announces the moving of its Buffalo Sales and Service Branch to: 128 West Chippewa Street, Buffalo, N.Y. This is a direct factory service branch in charge of trained company personnel.

Important Promotions in Universal Atlas Organization

New elections and appointments in the Universal Atlas Cement company are announced by Blaine S. Smith, president, as follows:

George H. Reiter, vice-president, and W. L. Greenly, assistant to vice-president, Chicago.

A. C. Cronkrite, vice-president, and Paul F. Keatinge, assistant to vice-president, Chicago.

O. H. D. Rohwer, vice-president, and James D. Scovel, assistant to vice-president, Chicago; George S. Neel, sales manager, Des Moines; L. B. Thomas, district sales manager, St. Louis.

A. O. Stark, vice-president, New York; W. R. Heckendorn, sales manager, New York; W. A. McIntyre, sales manager, Philadelphia; Floyd L. Mabie, manager, Atlas White bureau, New York.

F. L. Stone and Paul C. Van Zandt also are vice-presidents of the company.

With few exceptions, all the elections and appointments are of men with long service with the Universal Atlas company, according to the announcement. They are promotions, it is pointed out, and reflect the company's policy of advancing members of the organization as opportunities arise.

▼

Edward L. Westwood Manages Wheeling Culvert Department

Announcement has been made by the Wheeling Corrugating Company, Wheeling, West Va., of the appointment of Edward L. Westwood as manager of the Wheeling Culvert Department. Mr. Westwood will be located at the general offices in Wheeling. Formerly he was with the Wheeling Metal and Manufacturing Company.

▼

Death of William C. Stettinius

William C. Stettinius, age 41, a director of Worthington Pump and Machinery Corporation and other organizations, died in Baltimore on July 20. He was the son of the late Edward R. Stettinius, former Assistant Secretary of War and partner of J. P. Morgan and Company, whose widow survives. Surviving also are the wife, the former Miss Achsah Petre, and four children. Mr. Stettinius was a captain in the Army during the World War and was wounded twice in France.

▼

Girton Now with Tractor & Equipment Co.

Willis A. Girton of Indianapolis has joined the organization of the Tractor & Equipment Co. (Chicago and Springfield, Ill.) to be in charge of territory east and north of Peoria, Ill. Although most of Mr. Girton's long experience in the contractors' machinery business has been in Indiana, first with the G. E. Hillsman Co. and later with the H. W. Taylor Co. of Indianapolis, he is not unknown in Illinois, having been associated with the Peoria Tractor & Equipment Co. of Peoria for a considerable period of time.

Neil E. Jersey Becomes Vice President and General Manager of W. A. Riddell Corp.

Neil E. Jersey, who has been connected with the W. A. Riddell Corporation, Bucyrus, O., and its predecessors for the past twelve years, and is well and favorably known in the road machinery industry, has been elected to the vice presidency and general managership of that corporation, as per announcement made by the corporation's president, Clark T. McConnell. Mr. Jersey's election to this post was caused by the sudden death of the former vice president and general manager, H. F. Holbrook, who succumbed to a heart attack on June 24th, after an illness of only a few days.

Neil E. Jersey

Mr. Jersey became connected with the W. A. Riddell Co. in 1924, in charge of their designing, experimental and research department, and the rapid and outstanding development of the now favorably known "Warco" line of Motor Graders stands as a testimonial to his tireless efforts. In 1928 he assumed active charge of the road machinery sales department, and while he carried the title of manager of road machinery sales, he actually had complete charge of the engineering, manufacture and sales of "Warco" road machinery.

Mr. Jersey will retain final jurisdiction in all matters pertaining to sales policy and will be assisted in road machinery sales by his former assistant sales manager, C. A. Beal, who has been promoted to a newly created position which will be known as "manager merchandise bureau, in charge of general office road machinery sales work, sales promotion and advertising."

Mr. W. G. Beebe, the secretary of the corporation, in addition to the duties of that office and those of general office manager, will locally represent the treasurer in the duties of comptroller.

The "American" line of brick and clay working machinery, which has been made in this plant for more than fifty years, is under the jurisdiction of Lambert Haigh, a specialist in the brick and clay machinery industry.

▼

New Lincoln Sales Office in Sacramento

The Lincoln Electric Co., manufacturer of arc welding equipment, Cleveland, O., announces it is now providing arc welding users in Sacramento and the central valley of California, complete arc welding sales and engineering service. The Lincoln Sacramento representative is Mr. William F. Fischer, address—1241 32nd St. Although Mr. Fischer works out of the San Francisco office under the management of S. H. Taylor, Jr., he is stationed in Sacramento.

▼

New Distributors for Hercules Co.

The Hercules Co. of Marion, Ohio, has recently appointed the following distributors for their line of road rollers: Jackson Machinery Co., New Orleans, La.; Bublitz Machinery Co., Kansas City, Mo.; Industrial Tractor & Equip. Co., Nashville, Tenn.; Moriarty Machinery Company, Toledo, O.; Tractors, Incorporated, Providence, R. I.; J. F. Murphy Engineering Co., Memphis, Tenn.; Lewis Patten Co., San Antonio, Tex.; C. O. Monat Company, Ltd., Montreal, Canada.

H. L. Hart Becomes General Sales Manager of Wico Electric Co. C. L. Allen Succeeds Hart in Chicago Office

Announcement of the appointment of Harrison L. Hart to the position of general sales manager has been made by E. L. Stoughton, president of the Wico Electric Co., Springfield, Mass. Mr. Hart came to Chicago in September, 1934, as manager of the company's western office.

Harry Hart joined the Wico organization in October, 1913. He went into the shop immediately after leaving school and served in various departments during the next two years. When he had learned how to build magnetos he went on the road and for the following six years sold and serviced them.

In 1916 he left the company to join the army on the Mexican border, and in 1917 joined the American Expeditionary Forces as a flyer and served in the World War. He is a graduate of the Georgia School of Technology where he received his degree of aeronautical engineering.

Following the war, Mr. Hart returned to the Wico Electric Co., as assistant sales manager. Later he became purchasing agent and had charge of costs and production. He continued in this capacity until the death of W. L. Kaiser in 1934 when he was sent to Chicago.

Carter L. Allen will succeed Mr. Hart in charge of the Chicago office. Mr. Allen has been associated with Wico for the past fourteen years. For the past year and a half he has been assistant in Chicago. He was service manager at the factory before coming to Chicago.

▼

R. G. Dickens Represents Hilliard Clutches in Chicago

The Hilliard Corporation, Elmira, N.Y., has placed Mr. R. G. Dickens in charge of sales and services of all types of Hilliard Clutches in the Chicago District.

For 20 years prior to his transfer to Chicago, Mr. Dickens was Chief Clutch Engineer at the Elmira plant, and was instrumental in the research and development work that preceded the introduction of Hilliard Over-Running Clutches. His office is at 201 North Wells Street.

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Published Monthly by
GILLETTE PUBLISHING COMPANY
400 West Madison Street
CHICAGO, ILLINOIS

THIS MAGAZINE IS DEVOTED TO
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